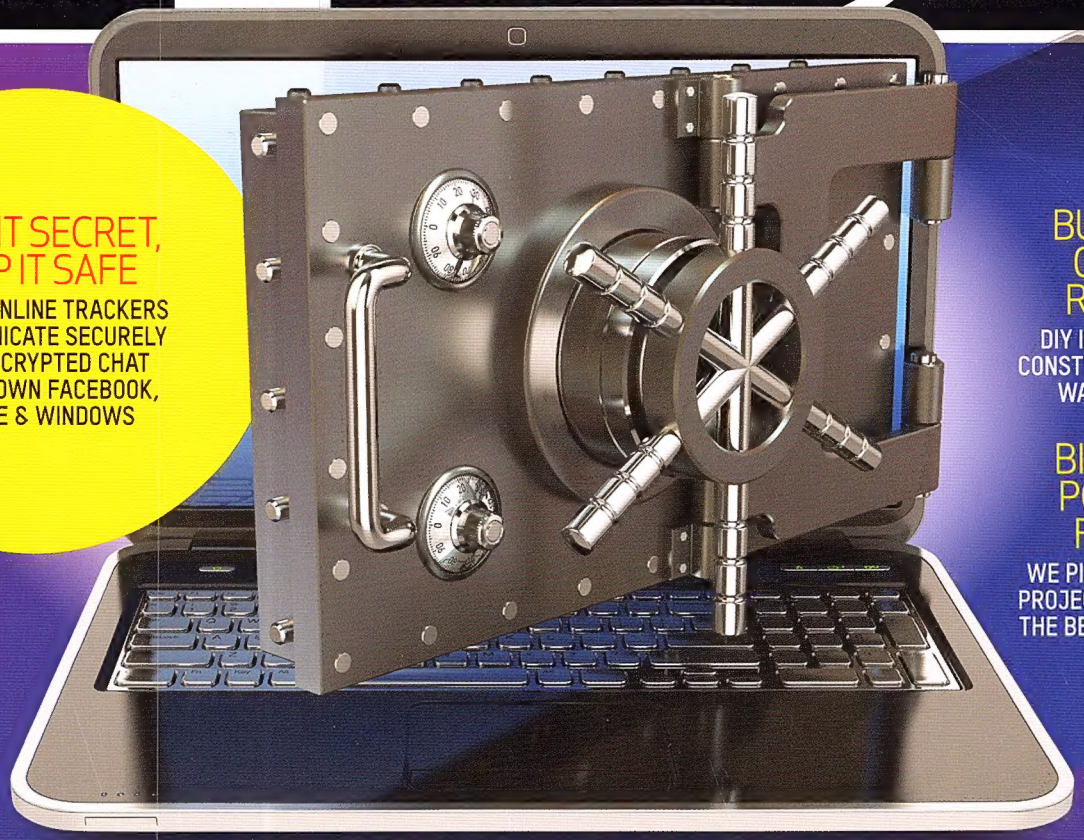
MICROSOFT'S $599 SURFACE GO REVIEWED

IS THIS BUDGET TABLET THE iPAD KILLER WINDOWS FANS HAVE BEEN WAITING FOR?

a-pc

Oct 2018
Issue 459

YOUR EXPERT GUIDE TO TODAY'S TECH



KEEP IT SECRET, KEEP IT SAFE

> BLOCK ONLINE TRACKERS
> COMMUNICATE SECURELY WITH ENCRYPTED CHAT
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NEW PERIPHERALS, PCs & GADGETS REVIEWED

> MICROSOFT CLASSIC INTELLIMOUSE: THE ORIGINAL GAMING MOUSE RETURNS
> WE HAVE SEEN THE LIGHT: RAZER 'OPTO-MECHANICAL' KEYBOARD
> ASUS PG27UQ GAMING SCREEN: 4K, G-SYNC & HDR... FOR *HOW MUCH?*

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4G LTE
Vigor2862L Series

Mobile Internet Solution for Small-to-Medium Businesses

DrayTek Aust & NZ
www.draytek.com.au

Multi-WAN router with 4G LTE SIM card slot (150/50Mbps), VDSL2/ADSL2+, Gigabit Ethernet WAN, IEEE 802.11ac (AC2000), SPI Firewall, and 32 x VPN tunnels including 16 x SSL-VPN tunnels

Vigor2862Lac

Vigor2862L

Aust/NZ VDSL NBN Ready

Ethernet WAN NBN Ready

Ethernet WAN UFB Ready

SIM Card

32x VPN

LTE/4G Specification

LTE/4G category 4
150Mbps downstream and 50Mbps upstream
4G LTE FDD Band: 1, 3, 4, 5, 7, 8, 28
4G LTE TDD Band: 40
3G WCDMA Band: 1, 2, 5, 8

The LTE feature makes the Vigor2862L series router an ideal solution for applications such as:

- Provision of Internet access on public transport such as coaches, buses, trains, freighters, etc.
- Temporary installations such as disaster recovery and emergency situations, exhibitions, sporting events, etc., where Internet access is required for a short period.
- Quick setup for new branches waiting for xDSL/Ethernet WAN (e.g. NBN)
- Remote locations with no fixed line or NBN coverage.
- Load Balancing or Failover backup for an existing primary Internet connection which can be any of ADSL/VDSL/Cable/Ethernet broadband.

Key Features

- Card slot for FDD & TDD 4G LTE SIM card supports band B1/B2/B3/B4/B5/B7/B8/B28/B40
- VDSL2/ADSL2+, Gigabit Ethernet WAN port, 1 x USB port, and 1 x 4G LTE SIM card slot
- 1 x USB 2.0 port for 3G/4G LTE Modem, FTP server, network printer or temperature sensor
- Single WAN or Multi-WAN Load Balance and Failover
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- Integrated IEEE 802.11ac (AC2000) Wave 2 wireless Access Point; dual band; up to 1.7Gbps throughput for Vigor2862Lac
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- Supports QoS functions
- IPv6 & IPv4
- Increased IP addresses (1022) and IP subnets (8)
- 16 x VLANs for secure and efficient workgroup management
- 32 x VPN tunnels (including 16 x SSL VPN tunnels) with comprehensive secure protocols
- Fast VPN throughput, VPN load-balancing and backup for site-to-site applications
- High Availability mode
- Central AP Management for deployment of multiple wireless VigorAPs
- Central VPN Management for 8 remote Vigor routers
- Free Smart Monitor Network Traffic Analyzer (30-nodes)
- Supports VigorACS 2 (Central Management System) for multi-site deployment
- 2 years back to base warranty

i-LAN TECHNOLOGY

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www.i-lan.com.au (02) 9838 8899 sales@i-lan.com.au

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Future Publishing Australia, PO Box 1077 Mount Street, North Sydney, NSW 2059
Tel: (02) 9955 2677 **Fax:** (02) 9955 2688
Email: apcmag@futurenet.com
Web: www.apcmag.com
Subscription enquiries: Please call CRM: (02) 8227 6486

Editorial
Editor-in-Chief **Dan Gardiner**
Chief Sub-editor/Journalist **Carmel Sealey**
Senior Journalist: **Shaun Prescott**
Senior Journalist: **Paul Taylor**
Journalist: **Joel Burgess**
Journalist: **Harry Domanski**
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Journalist: **Sharmishta Sarkar**
Creative Director: **Troy Coleman**
Designer: **Sharnee Swinnerton**

Contributors
Mike Bedford, Alex Blake, JR Bookwalter, Alex Cox, Anne-Marie Coyle, David Crookes, Alan Dexter, Nate Drake, Cat Ellis, Ian Evenden, Matt Hanson, Kenny Hemphill, Phil Iwaniuk, Luke Kemp, Jeremy Laird, Adam Marshall, Carrie Marshall, Rob Mead-Green, Bo Moore, Joe Osborne, Bennett Ring, Mayank Sharma, Zak Storey, Nathan Taylor, Oscar Taylor-Kent, Bill Thomas, Alexander Tolstoy, Alan Wen, Darren Yates

Photography
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Advertising
Advertising Manager: **Paul Marttila**
paul.marttila@futurenet.com

Management
Managing Director **Neville Daniels**

Printed by Blue Star PRINT (NSW)

Distributed in Australia and NZ by Gordon and Gotch
www.gordongotch.com

ISSN 0728-441

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What's your digital privacy worth?

Giving up on today's free products and services may not be practical for everyone, but *APC*'s editor reckons you can still negotiate a better deal.

The old adage that "there's no such thing as a free lunch" has perhaps never been more true than in our current age of ubiquitous 'free' digital products and services. As we've all been rudely made aware over the last few years, the price of services like Facebook and Google is, at the very least, some degree of your digital privacy.

The big tech companies do allow you to request a copy of all the data that's been collected on you and, if you've been using a service for years, that can often add up to gigabytes of information. And it's not just your search habits and likes that are being tracked, but also your movements in the real world. Google, for example, keeps a log of your location whenever you use its services (which, if you own an Android phone, is near-constant) and, as was recently revealed, there's currently no way to opt out of that collection – see page 58 for more details on that.

It's not just free services that are collecting data on your habits, either. Microsoft has been criticised over the amount of 'telemetry' data it gathers in Windows 10.

So should you be worried? In a Western democracy, we thankfully have some safeguards on how this data can be used and steps continue to be made to further clarify and, often, further restrict this – Europe's recent General Data Protection Regulation is a good example, and California's recent passing of the Consumer Privacy Act shows that, even in the Silicon Valley heartland, strong privacy protections are still something people care about.

Most of these bigger services also do a good job of keeping your information secure from outside hackers, although there have been instances of misuse by individuals inside the company.

The good news is that you've got options when it comes to using these free services. You can switch to more privacy-focused ones (and we've outlined our favourite alternatives on page 48) or, at the very least you can get a better bargain by reducing the amount of information you're divulging – which will at least reduce the size and complexity of that detailed dossier that every company keeps on you.

Personally, I'm largely happy doing the latter – although there are instances where I've chosen to use more private options, such as chat and web browsing.

What you're willing to give up when it comes to privacy is, of course, a very personal question, but with this month's superguide we hope to reduce some of the fog that surrounds the issue so you can make more informed decisions. ■

DAN GARDINER
EDITOR-IN-CHIEF
dan.gardiner@futurenet.com

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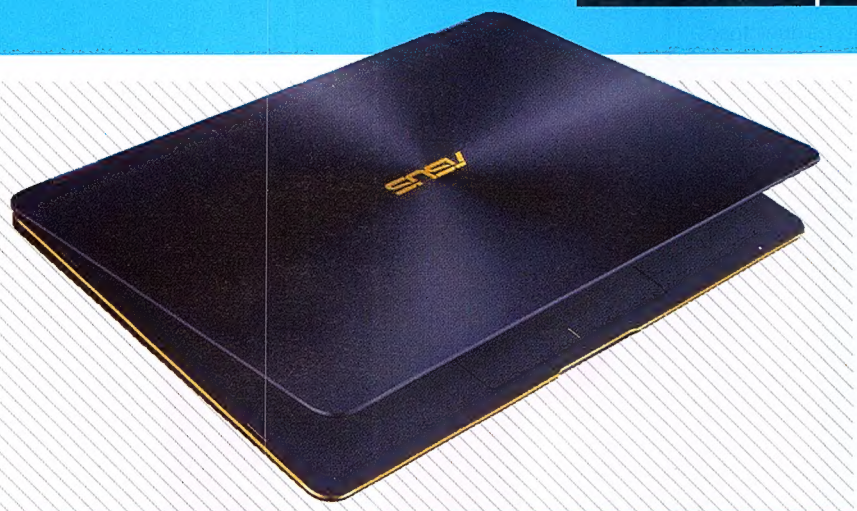
"We're quite fond of the colourful flourish on the front, a swooping line of illumination, as though the case has suffered a war wound and is now bleeding pure Las Vegas Strip."
Corsair Spec-06 RGB, page 37



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» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

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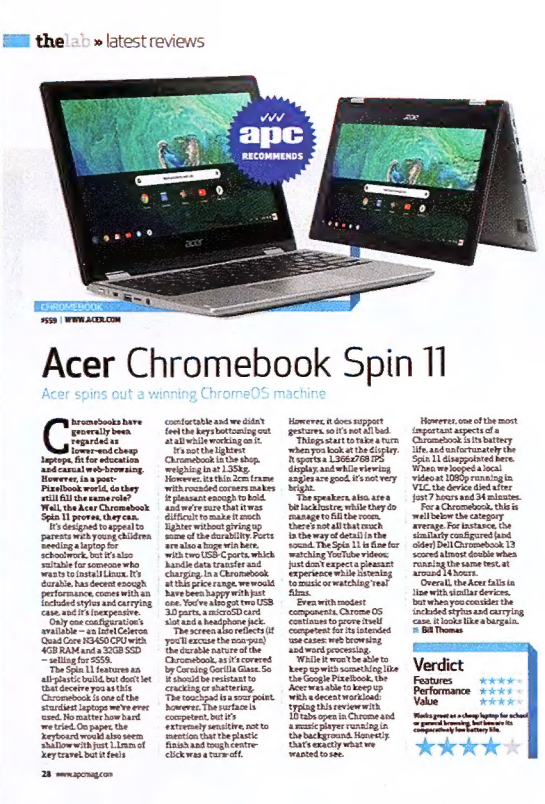
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Acer Chromebook Spin 11
Acer spins out a winning ChromeOS machine
Chromebooks have generally been regarded as lower-end cheap laptops, fit for education and casual web-browsing. However, in a post-Pixelbook world, do they still fill the same role? Well, the Acer Chromebook Spin 11 proves, they can.
It's designed to appeal to parents with young children needing a laptop for schoolwork, but it's also suitable for someone who wants to install Linux. It's durable, has decent enough performance, comes with an included stylus and carrying case, and it's inexpensive.
Only one configuration's available – an Intel Celeron Quad Core N3450 CPU with 4GB RAM and a 32GB SSD – selling for $559.
The Spin 11 features an all-plastic build, but don't let that deceive you as this Chromebook is one of the sturdiest laptops we've ever used. No matter how hard we tried. On paper, the keyboard would also seem shallow with just 1.1mm of key travel, but it feels comfortable and we didn't feel the keys bottoming out at all while working on it.
It's not the lightest Chromebook in the shop, weighing in at 1.35kg. However, its thin 2cm frame with rounded corners makes it pleasant enough to hold, and we're sure that it was difficult to make it much lighter without giving up some of the durability. Ports are also a huge win here, with two USB-C ports, which handle data transfer and charging. In a Chromebook at this price range, we would have been happy with just one. You've also got two USB 3.0 ports, a microSD card slot and a headphone jack.
The screen also reflects (if you'll excuse the non-pun) the durable nature of the Chromebook, as it's covered by Corning Gorilla Glass. So it should be resistant to cracking or shattering. The touchpad is a sour point, however. The surface is competent, but it's extremely sensitive, not to mention that the plastic finish and tough centre-click was a turn-off.
However, it does support gestures, so it's not all bad.
Things start to take a turn when you look at the display. It sports a 1,366x768 IPS display, and while viewing angles are good, it's not very bright.
The speakers, also, are a bit lacklustre, while they do manage to fill the room, there's not all that much in the way of detail in the sound. The Spin 11 is fine for watching YouTube videos; just don't expect a pleasant experience while listening to music or watching 'real' films.
Even with modest components, Chrome OS continues to prove itself competent for its intended use cases: web browsing and word processing.
While it won't be able to keep up with something like the Google Pixelbook, the Acer was able to keep up with a decent workload: typing this review with 10 tabs open in Chrome and a music player running in the background. Honestly, that's exactly what we wanted to see.
However, one of the most important aspects of a Chromebook is its battery life, and unfortunately the Spin 11 disappointed here. When we looped a local video at 1080p running in VLC, the device died after just 7 hours and 34 minutes.
For a Chromebook, this is well below the category average. For instance, the similarly configured (and older) Dell Chromebook 13 scored almost double when running the same test, at around 14 hours.
Overall, the Acer falls in line with similar devices, but when you consider the included stylus and carrying case, it looks like a bargain.
Bill Thomas
Verdict
Features
Performance
Value
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Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

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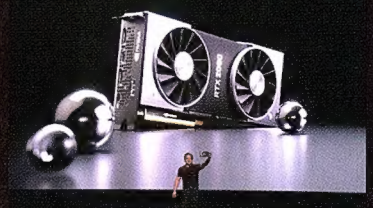


Nvidia finally announces 20-series graphics cards

RAY-TRACING SUPERSTARS.

During its Gamescom 2018 showcase in Cologne, Germany, Nvidia revealed its brand-new GeForce line of graphics cards. The RTX 2070, RTX 2080, and RTX 2080 Ti GPUs are capable of delivering 6, 8, and 10 GigaRays of ray tracing respectively, enabling them to compute how light and sound travel in a 3D environment at rates up to 25 times faster than the previous Pascal architecture. **HD**

Google Assistant will brighten your day with its new good news feature

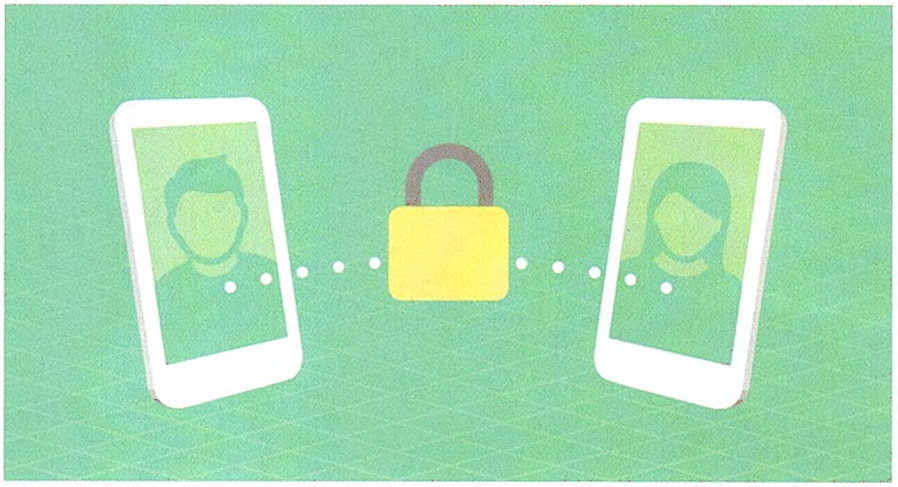
GOOD NEWS, EVERYONE.

Google is introducing a feature called 'Tell Me Something Good' to its Assistant, a request that will deliver stories that focus on the improvements we're making to society rather than its flaws. While Google acknowledges that the feature isn't likely to be a "magic solution" for our news woes, it will provide a small reprieve to those of us feeling a bit burned out by the daily deluge of hard-hitting stories. **HD**

Study suggests confiscating phones helps students concentrate

SURPRISE, SURPRISE!

A study published in *Educational Psychology* journal has confirmed the somewhat unsurprising conclusion that the classroom use of digital devices for non-academic purposes will negatively influence student performance. The study found that students who were in classrooms allowing the use of devices (even if they didn't use one themselves) displayed a 5% drop in marks in the subject's final exam. **HD**



Encrypted communications targeted by new Australian anti-crime laws

Big tech will be forced to assist law enforcement.

Back in July 2017, the Australian Government stated its intention to introduce new legislation that would force companies to decrypt secure messages, and the details surrounding the proposed laws have finally come to light. While Australian telcos already offer a degree of assistance to the country's law enforcement, providing user data in investigations relating to high-level crime, the government's concern is that the same cooperation isn't currently provided by big tech companies that offer encrypted messaging services.

An exposure draft of the Assistance and Access Bill 2018 has revealed legislation that will allow certain high-ranking security officials to formally request access to encrypted communications from the providers of those services. While the companies being issued the requests are initially only asked to hand over information on a voluntary basis, this can be escalated to an official notice, which would "require" companies to provide the data where available, or to devise a means of obtaining the data if not. Critics of the legislation have pointed out that this could undermine the security of end-to-end encrypted messaging, which would otherwise see the communications unconditionally protected until it reaches the recipient's device. **Harry Domanski**

Facebook is using a reliability score to stamp out trolls

ARE YOU A FAKE FLAGGER OR A TRUSTY TIPPER?

In Facebook's ongoing fight with fake news, it employs a number of methods to help weed out falsehoods from the truth, and now we know how the company watches the watchmen. A Washington Post investigation has revealed that Facebook assigns its users a reputation score between 0 and 1. When a user flags a post as containing false news, their score is adjusted based on the veracity of this tip. So, for users who consistently flag posts that genuinely contain fake news, their score will rise and Facebook will lend their future tips more weight, whereas the opposite is true of those that continuously report legitimate news. The score has been introduced to combat the growing problem known as 'brigading', which sees organised groups of trolls or political activists deliberately flag posts in the hopes to suppress or censor them. At present, this is strictly an internal measure and there is no way for users to check their reputation score, a precaution likely put in place to avoid any further gaming of Facebook's systems to drive personal or political agendas. **Harry Domanski**

EU regulators may force Apple to ditch Lightning for future iPhones

Union frustrated at lack of progress in creation of single standard.

The European Union (EU) will study whether there is a need for more action to force the mobile industry to adopt a common charger that can be used with any smartphone. European policymakers have been keen for a single standard for more than a decade.

Their reasons? The significant amount of electronic waste caused by unused chargers, and the inconvenience suffered by Android and iPhone users who need different cables for different devices. Although much of the industry has since settled on the newer USB Type-C plug, Apple is still pushing its proprietary Lightning standard, which it originally launched with the iPhone 5 in 2012. Lightning is now used in all models of the iPhone and iPad, with Apple claiming the connector affords it more freedom to design its products.

"Given the unsatisfactory progress with this voluntary approach, the Commission will shortly launch an impact assessment study to evaluate costs and benefits of different other options," EU Competition Commissioner Margrethe Verstager said in a statement to Reuters. It would seem as though Apple would be most vulnerable to any such move and could be forced to adapt the designs of its new devices if the EU decides to take action. **Harry Domanski**

Most NBN customers finally get the speeds they pay for, according to ACCC report

THINGS ARE SPEEDING UP, THEN?

While the rollout of Australia's national broadband service has admittedly not been a smooth ride, things do seem to have been improving over the course of 2018. According to the ACCC's second 'Measuring Broadband Australia' report, only 7.4% of NBN customers are receiving less than half the maximum internet speed promised in their chosen plan. While that percentage is still a significant number, the ACCC report finds that it could be due to "physical limitations" — like the use of old routers that don't support high speeds — rather than shortcomings in the amount of available bandwidth or other larger infrastructure issues. On the other hand, around two-thirds of users are seeing speeds that are at least 90% of what their plan promises.

While there hasn't been much improvement in speed delivery performance by the telcos since the release of the Measuring Broadband Australia report back in March, ACCC chair Rod Sims says he is "encouraged" by the results, but adds that "we must focus our attention on those who do not have this experience". **Sharmishta Sarkar**

Hack-happy Aussie teen cracks Apple's vault, steals 90GB of confidential files

FINALLY GETS CAUGHT AFTER APPLE CALLS THE FBI.

An Australian private schoolboy from Melbourne has pleaded guilty to charges of repeatedly hacking into Apple's main computer network when he was 16, stealing 90GB of sensitive files over the course of a year. Although there is no official word on the matter, a report claims that the AFP found the stolen documents in a folder fittingly entitled "Hacky hack hack". **HD**

Sydney Uni and major banks fund cybersecurity program for schools

BOLSTERING ONLINE SAFETY AND CAREER PROSPECTS.

More than 30,000 high school students country-wide will take part in a Cyber Security Challenges program that aims to teach students from years 7 to 10 the ins and outs of online safety. Along with Sydney University, the Commonwealth Bank, NAB, ANZ and Westpac will help fund and deliver the program, which also aims to promote the future of cyber security as a hot career prospect. **HD**

Revised NSW road rules will heavily penalise drivers caught using their phone

FROM SEPTEMBER 2018, YOU'LL COP MORE DEMERITS.

In addition to installing new tech in traffic cameras that automatically detect phones, NSW drivers will cop five demerit points for the illegal use of mobile phones while on the road from September. Drivers are allowed to use their phones for calls, music and navigation, but only if the device is in a cradle. However, learner, P1 and P2 drivers aren't allowed to use a phone at all. **HD**

numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

$2.39 billion

AMD HAS HAD ITS BEST FINANCIAL QUARTER SINCE 2011, COURTESY OF RYZEN AND EPYC

Q2 of 2018 was a very exciting time for AMD, as the microprocessor manufacturer celebrated its strongest financial quarter since 2011. Thanks in no small part to the continuing success of Ryzen and Epyc CPUs, which saw a 64% 'ryze' (ahem) in revenue from Q2 2017. Overall company revenue was up 53% from $1.56 billion to $2.39 billion year-on-year, bringing the net income back into the black after last year's $57 million loss.

1 in 5

PORTION OF AUSSIES THAT THINK THEIR SMARTPHONES ARE SPYING ON THEM

Ever thought that the targeted advertisements you were seeing were a little... too targeted? **Finder.com.au** asked thousands of Australians and found that nearly 20% of them believed their phone to be eavesdropping on them in order to promote their services. As for demographics, it was the young Gen Zers (18–23) who were the most suspicious, with 37% of those surveyed convinced their handset was a spy, with Gen Y, Gen X and the Baby Boomers following with 33%, 12% and 4%, respectively.

ONE TRILLION DOLLARS

APPLE OFFICIALLY BECOMES THE FIRST EVER TRILLION-DOLLAR BUSINESS

While Apple was hovering just beneath the historic 13-figure number since late July, it wasn't until early in August when its stocks rose 2.7% to US$207.05 — the highest in company history — that it became official. Apple is now the world's first trillion-dollar business (US dollars, that is). Following the Cupertino giant is Amazon on US$878 billion, Alphabet on US$854 billion and Microsoft on US$824 billion.

3,300 TONNES

AMOUNT OF LI-ION BATTERY WASTE AUSTRALIA PRODUCES EACH YEAR

A report from the CSIRO has revealed that Australia produces 3,300 tonnes of lithium-ion battery waste annually, and with this number growing roughly 20% year-on-year, it's expected to hit 100,000 tonnes by 2036. Unfortunately, only 2% of this waste is currently being properly recycled, leading the CSIRO to push for improved education and processes to be put in place. As much as 95% of the materials used in a lithium-ion battery can be recycled into new batteries or related fields, if the process is undertaken correctly.

78%

PORTION OF ICOs IN 2017 THAT WERE ACTUALLY SCAMS

For the uninitiated, Initial Coin Offerings (ICOs) are the cryptocurrency equivalent of an IPO, where a company sells its crypto tokens to prospective investors who hope that it will, someday, climb in value. Given the decentralised nature of cryptocurrency, and the ability for ICOs to avoid most regulatory practices, they have become a popular method of fraud. In fact, a study by Bloomberg has found that roughly 78% of the ICOs that were made during 2017 were scams, while a further 7% had failed.

techbrief

» CARMEL SEALEY TAKES A DEEPER LOOK AT A TRENDING NEWS TOPIC

Wearables that can save your life

The devices with added smarts that really could do you a world of good.

It's all well and good to crow about the latest in-depth sports features included in your smartwatch or the extra two minutes of battery life that the manufacturer has managed to squeeze into its latest flagship, but what technology could actually make the biggest difference to the way people live their lives? While smartwatches are indeed making big strides towards non-invasive health monitoring, it's the dedicated devices that still have the edge on keeping track of your wellbeing. From malaria to asthma, diabetes to broken bones, there are numerous inventions out there to monitor your health, alert you of any abnormalities or even physically act to keep you safe. Here are five such devices that we've recently found.

ActiveProtective smart belt

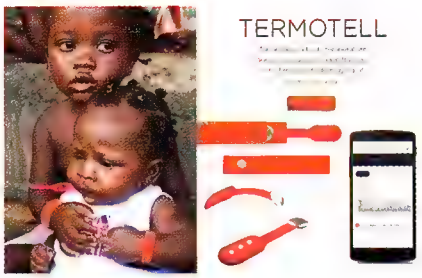
Hip protection for the elderly

If only clothes were a bit more like cars. No? Well, ActiveProtective has created a belt designed to be worn by seniors that has a "highly accurate fall-in-progress detection" system, which will deploy airbag-like protection around the hips to reduce the impact taken on the hard floor. Not only will it help prevent injury, it will give the elderly wearer more confidence to move around, which will be good for their health and wellbeing!

Owlet Smart Sock

Track your infant's heart rate and oxygen levels while they sleep.

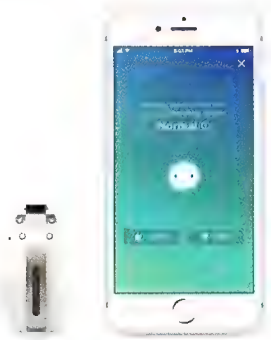
New parents are understandably paranoid about their newborn's health, and with horrors such as SIDS and croup, something like the Owlet Smart Sock could ease a lot of worries. This non-invasive wearable monitors the baby's heart rate and breathing, giving the parents real-time notifications if anything seems amiss. Not only that, it aims to educate parents on the best ways to look after their children. No complaints here!



TermoTell

Monitor body temperatures to battle malaria.

Hundreds of thousands of children die each year from malaria, so anything that could alert either the sufferer or their doctors of changes to their temperature could give them priceless time to act. This wearable is a bracelet designed to be worn by children up to the age of five and monitors body temperature and humidity. If a dangerous temperature pattern is detected, it will glow and send an alert advising to seek medical attention.



3M Respiratory Tracker

Helping asthmatics track their triggers.

With an estimated 235 million people around the world suffering from asthma (according to the World Health Organization), it's no wonder this crowdfunding project blew past its goal three times over. Designed to track asthmatics' breathing quality in different conditions, it also helps sufferers understand their triggers and enable them to take back control of their health. It's not the most attractive wearable but it's small and bloody useful.

Dexcom G5

The mobile CGM system for diabetics.

Primarily used for people with Type 1 diabetes (the one you can't prevent), the G5 is a "discrete sensor located just underneath the skin" on the abdomen and provides "real-time glucose readings [...] every five minutes". That glucose data is then sent to the wearer's phone or watch to provide valuable information about their levels, all without having to whip out a needle! It naturally also sends alerts if it detects levels are trending too high or too low. ■

gadgets

» GEAR WE WANT

GOOGLE HOME MAX

Turning up the volume on smart speakers.

$549 | STORE.GOOGLE.COM

Google's Home launched in Australia late last year and offered a reasonably-affordable way to get smart-assistant functionality anywhere in your house, but after crunching the numbers, Google discovered that its smart speakers are predominantly used for listening to music. Google's third Home smart speak has taken a while to reach Australian shores, but it has that music use-case fully in mind – the Max packs a pair each of 4.5-inch woofers and custom 0.7-inch tweeters, which combine to produce sound that's far more precise and 20 times more powerful that the regular-sized Google Home. Six far field microphones that can hear commands over loud music are built-in, and these can also work alongside the AI Smart Sound software to adjust the EQ based on the room's audio dynamics. **JB**

SONOS BEAM

A soundbar that has us beaming from ear to ear.

$699 | WWW.SONOS.COM

With so much competition in the wireless speaker space, nowadays old-timer Sonos has to do a lot more to stand out the market it helped create. 'A lot more' is, thankfully, exactly what the new Beam soundbar delivers. It's the first Wi-Fi speaker to integrate a digital assistant into a soundbar – making for a 2-in-1 combo that'll arguably be the most important speaker in your home. This modern smart speaker isn't just a good all-rounder either; it also comes at a price that should appeal to a much broader audience. When you consider that it outputs premium sound for movies and TV as well as a high quality music streaming – and even adds smart speaker capabilities to your telly – it just might be the perfect all-in-one home speaker. **JB**

OPTOMA UHZ65

The 4K projector that makes frikkin' laser beams affordable.

$8,999 | WWW.AMBERTECH.COM.AU

When it comes to projectors, you need to go laser if you want the best picture possible. But buying this kind of cinema-quality tech has always been the reserve of the really rich... until the UHZ65 arrived. This projector blows the mind with its HDR pictures, with its laser system creating deep blacks and vibrant colours. The 4K image is also packed with detail. It's not too large either, so you won't need to create a whole home cinema space just to accommodate it. And believe it or not, that $8,999 price tag is actually super-affordable for a projector with these kind of specs.

SAMSUNG GALAXY WATCH

Now's the time of the smartwatch.

FROM $549 | WWW.SAMSUNG.COM/AU

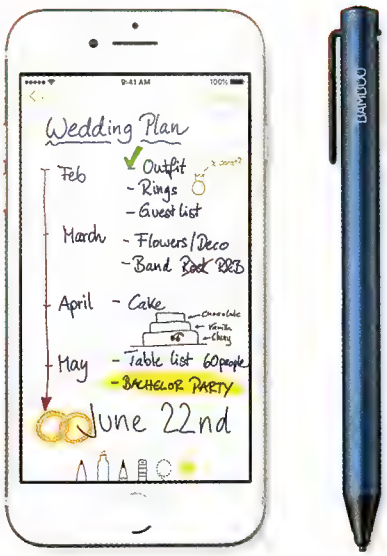
It's clear that Samsung's determined to be different with its latest smartwatch, but apart from the new name (which drops the 'Gear' moniker) the Galaxy Watch introduces LTE connectivity, 5ATM waterproofing and a bigger battery to an already impressive wearable lineage. That LTE connectivity's set to power Samsung's exclusive Spotify streaming integration — which even that Apple Watch doesn't yet have — and the improved waterproofing and Corning Gorilla Glass DX+ face should give the Galaxy Watch the resilience to go wherever you do. This watch's most revolutionary new feature, however, is perhaps its new battery. The 46mm model Galaxy Watch squeezes in a 472mAh battery, which should effectively double the life and provide up to 80 hours of regular usage. **JB**

WACOM BAMBOO TIP

Not just the tip.

$79.95 | BUYWACOM.COM.AU

If you're anything like us, typing out quick notes on the phone or tablet later becomes an exercise in archaeology, requiring you to grab your hat and whip and spend hours trying to decipher what the hell your sausage fingers had previously punched in. If that sounds familiar, Wacom has you covered. Forged from anodised aluminium, the 10mm diameter, 16g Bamboo Tip stylus is perfectly weighted in the hand and ready for action. It'll sync with your iPhone, iPad and your Android devices on-the-fly for seamless drawing, note-taking or collaboration. The 20-hour rechargeable battery life is also great. And unlike traditional capacitive styluses, which are often imprecise due to their wide foam tip, finer details are a cinch for the 1.9mm Tip's... tip. A must-have for anyone who likes to jot or doodle on the go. **TC**



SONY MASTER SERIES A9F

Mastering the ancient art of couch-potatoing.

$TBC | WWW.SONY.COM.AU

When it comes to tellies, it's easy to get befuddled by all the alphanumeric names. But there's nothing confusing about the sheer awesomeness of Sony's new Master series of 4K HDR TVs. The tech giant's aim with the A9F OLED (available in 55- and 65-inch sets) is to create "a picture approaching the quality of a professional-grade monitor in a motion-picture studio". Plus, with the help of its own next-gen picture processor, X1 Ultimate, Sony has achieved the kind of supreme accuracy and detail that you'd expect to find from the master. Sony's also teamed up with Netflix to offer a dedicated Netflix Calibrated Mode. What's that? Switch it on in the menu bar and your fave Netflix shows will come alive in exactly the way their creators intended. Prepare to fall in love with *Stranger Things* all over again. ■

Head to head: PC monitor vs HDTV vs projector

A big-screen PC is a blast.

In days of yore, hooking up a PC to a TV via a low-res analog interface was fun, but it was also blurry, borky, and sub-optimal. Today, everything is crisp, clean, and digital. TVs offer high-res 4K panels that match or exceed most PC monitors for pixel count, and in the case of TVs with HDR support, colour depth and contrast, too. Even projectors now support proper PC-size pixel grids. So, what makes for the best big-screen PC experience?

If you want a superwide screen, it has to be a PC monitor.

Round 1

PRICE

In this age of dirt-cheap HDTVs, you might think there can be only one winner. After all, how do you argue with something like a cheapo 40-inch 4K TV on sale for something ridiculous like $600? In terms of absolute wallop for your wallet, you don't. However, the affordability of the latest HDTVs has happily had a knock-on effect for the PC monitor market as a whole.

For instance, there are several monitors that are essentially 4K TVs repackaged and fitted out with electronics more suitable for PCs. Such screens are far cheaper than they otherwise would be, thanks to the huge volumes in which those big HDTV panels are cranked out. More generally, HDTV production on an epic scale pushes down the price of LCD panel tech, and has shifted expectations when it comes to the resolutions of cheaper screens. In short, 4K has become the norm thanks to HDTVs, not PC monitors.

As for projectors, they don't really get a look in when it comes to value. Big, bold, and cinematic they may well be, but when even the cheapest true 4K projector costs thousands of dollars, a beamer isn't even in the running when it comes to bang for buck.

WINNER:
HDTV

Round 2

PIXEL PITCH

This is where PC monitors used to have their big advantage over hooking up an old-school CRT TV via S-video or component. PC monitors typically had a huge resolution advantage, while also being physically smaller. Cue massive pixel advantage. That's no longer quite as true. 4K HDTVs now offer 3,840 x 2,160 pixel grids, and that's pretty much as good as it gets for computer monitors. Granted, some 5K and even 8K monitors do exist, but they're typically very pricey affairs.

However, particularly when it comes to productivity work, a good PC screen is about more than simply pixel count. Pixel pitch counts, too, and it counts against both projectors and HDTVs. The bigger the screen, the bigger the pixel, leading to less clarity and sharpness, rougher font rendering, and so on. Moreover, if you're not increasing the overall pixel count, you're not getting any additional on-screen elbow room to work with. Of course, you could sit further away from your HDTV or projector screen, and thus solve the pixel pitch problem, but if the apparent size is then the same as a smaller monitor situated closer, what is actually the point in having the larger screen?

WINNER:
PC monitor

Round 3

CONNECTIVITY

Another area where TVs and projectors used to fall short; the connectivity gap has shrunk of late thanks to digitisation. The HDMI 2.0 interface used by HDTVs and projectors, for example, is broadly comparable with DisplayPort 1.2 when it comes to bandwidth. Both support full 4K resolutions at 60Hz refresh.

But that's not the full story. The PC-centric DisplayPort interface is far more flexible and offers not just multimedia transmission, but also compatibility with USB Type-C's alt modes, plus features such as daisy-chaining. That means you can use a single cable to connect a PC to a monitor, and have everything from image and sounds to USB connectivity and even charging catered for. The HDMI ports in HDTVs and projectors aren't nearly as powerful and versatile.

HDMI's support for more advanced features is also patchy, and adoption of updates to the standard tends to slow as the industry favours compatibility over capability—support for adaptive refresh via HDMI remains rare, for example. 4K at 120Hz also remains the preserve of monitors with the latest DisplayPort 1.4 interface, for now. The upcoming HDMI 2.1 standard ups the bandwidth ante, but isn't offered by any PC graphics card yet.

WINNER:
PC monitor

"If you're on a tight budget and you want a big, beautiful 4K screen, for instance, an HDTV is not only a great solution, it may be your only option."

Unbeatable big-screen bang for your hard-earned buck comes with an HDTV.

Beamers make for fulsome if inflexible big-screen fun.

Round 4

IMAGE QUALITY

Not long ago, image quality would have been a sure win for PC monitors. Lately, the comparison has become more complicated, thanks to the emergence of new HDR, or High Dynamic Range, standards in the HDTV market.

HDR means greater differences between the brightest and darkest areas of the screen, and thus better contrast. But HDR standards also incorporate extended colour spaces, and thus a wider range of colours. Meanwhile, the PC monitor market has been slow to adopt HDR. The consequence is that many HDTVs now have the edge on mainstream monitors when it comes to colour depth and contrast. The latest HDTVs also often offer reasonably low input lag when receiving a PC signal.

The qualifier is that those on-paper capabilities don't always translate into better image quality in all areas. HDTVs tend to use aggressive image processing, which can sacrifice accuracy in favour of superficial pizzazz. As for projectors, it's a tough comparison to make. Projectors, too, have embraced HDR technology, but the need for a dark viewing environment and the inherent difference between transmissive and reflective technologies put projectors in a category of their own.

WINNER:
PC monitor

Round 5

FEATURES

The features offered by monitors, TVs, and projectors reflect their remits. So much depends on what you want to do. Gamers will find that features such as adaptive sync support and low-input-latency modes are exclusive to PC monitors designed for gaming. Likewise, productivity features, such as USB hubs and accurate factory colour calibration, are the preserve of PC monitors too.

PC monitors also tend to be better engineered for mounting and being situated ergonomically on a desktop, be that courtesy of an adjustable stand, VESA mount compatibility, or the range of LCD panel aspect ratios on offer. TVs hit back with multimedia features such as built-in tuners, smart TV platforms, and impressive app support. Indeed, an HDTV is the only one that can function on its own and do things like play back video files from a USB stick. In effect, HDTVs have computers built into them.

Projectors tend to have a much narrower remit, and with that comes fewer features. Some support wireless connectivity in order to improve mounting options and reduce the need for running cables, but that aside, specific features to support PC gaming or productivity are non-existent.

WINNER:
PC monitor

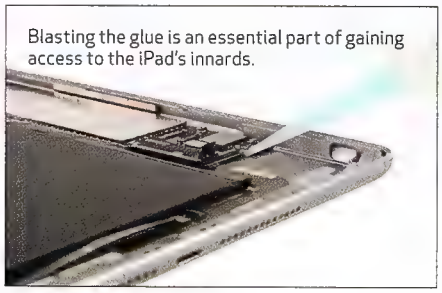
And the winner is...

So, PC monitors come out on top for use with PCs. Not exactly a newsflash, you cry? Maybe not. But despite the scale of the victory in terms of category wins, this contest is much closer than it looks. If you're on a tight budget and you want a big, beautiful 4K screen, for instance, an HDTV is not only a great solution, it may be your only option. The latest Ultra HD TVs offer far better image quality than the TV sets of old, too.

However, the strength of the PC monitor is that its features and performance are optimised for PC usage. It's better at connecting with PCs, more suited to displaying a PC's output, and more physically compatible with a PC's usual working environment. Whether it's high refresh rates for games, colour accuracy for producing content, or something as simple as font rendering for reading, PC monitors remain your best bet when using a PC. The exception involves home theatre and multimedia PCs, where the huge, cinematic scope of an HDTV and particularly a projector can create images and a viewing experience on a whole different scale. ■

howit'sdone

You'll reach the LCD panel quickly enough, but that's just the start of the journey.



Blasting the glue is an essential part of gaining access to the iPad's innards.

Apple iPad 9.7-inch (2018)

We rip open the cheaper iPad to see what's changed in this latest revision.

Unveiled at Apple's education-focused event in July, the 2018 iPad is less of a "hot new sequel" and more like a "revised edition paperback with improved illustrations." While this iPad's specs reveal two major updates – an upgraded processor, and Pencil support – has Apple quietly changed anything else? Let's find out with a teardown!

MAJOR TECH SPECS

- Apple A10 fusion processor with embedded M10 motion coprocessor
- 9.7-inch multi-touch Retina display with 2,048 x 1,536 resolution (264 ppi) and non-laminated display assembly
- 32GB or 128GB of storage
- 8-megapixel 1080p rear-facing iSight camera + 1.2-megapixel 720p front-facing FaceTime HD camera
- 802.11a/b/g/n/ac dual-band MIMO Wi-Fi + Bluetooth 4.2
- Touch ID fingerprint sensor + three-axis gyro + accelerometer + barometer + ambient light sensor
- Apple Pencil support

KEY FINDINGS

- We've been around this block a few times, so we're going to let ourselves in: iOpener brings the heat; suction and opening tool bring the prying leverage. Like magic, the digitiser panel lifts separately from the display – a good sign for repair. Non-fused display and digitiser glass are better in the event that either breaks. Important for a rambunctious classroom.
- After freeing some Phillips screws, we lift the LCD panel and disconnect it from the logic board. Before we go further, we slide a battery blocker between the battery and logic board to keep stray electrons from interfering with our teardown.
- Now we can safely disconnect the digitiser. It has the same two cables as before, but they look a little different. Could they have changed slightly for Pencil compatibility? Look what we found hiding under a shield: the same NXP 8461A1 Touch ID chip that we saw in the previous model.
- Strong adhesive binds the logic board to the case, so we meet it with some liquid fists. Pow! The offending adhesive quickly gives way, and the board comes out in one piece. And an unfortunate part of that piece is the Lightning connector, a high-use part that will very likely break before the rest of the logic board. You'll need some pretty serious microsoldering chops to pull off a simple port replacement here.
- We're pleased to see that Apple continues to use the battery from the iPad 5 – model number A1484 with a 32.9Wh capacity. Not only does this make more of the same battery available, but reusing existing manufacturing lines usually means less waste. We're not as pleased that it also brought over the same repair-impeding adhesive from the iPad 5. The good news is that you can already get a replacement battery.
- **Repairability score:** 2 out of 10 (10 is the easiest to repair). The LCD is easy to remove once you separate the cover glass/digitiser. Air-gapped, separately replaceable cover glass and LCD makes many drop damage repairs far less expensive. As in all iPads, a solid barrier of very strong adhesive bars the way to any repairs, and makes rework a sticky proposition. More adhesive holds nearly everything else in place. Battery replacement is especially challenging. The LCD has foam sticky tape adhering it to the front panel, increasing risk of damage during disassembly. ■

BiPAC 8900AX-2400

Wireless-AC 2400Mbps 3G/4G LTE
VDSL2/ADSL2+ VPN Firewall Router

PERFECT CHOICE, GENUINE VALUE

PC PowerPlay SMART BUY

PC & TECH AUTHORITY BEST VALUE

- VDSL(FTTC)/ADSL/EWAN for all connecttions
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Phone
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Email
sales@billion.com.au
sales@firstint.com.au

au.billion.com

epinions

"As mesh networks start to become the norm, there's less focus on the wireless performance of one router."

VPN SETUP GUIDE

Can I suggest an article on buying/setting up a VPN router on your home network so you can use a service like ExpressVPN to protect all the devices on your wireless network?

I currently have a Technicolor TG-1 NBN modem using VDSL on a FTTN connection. I don't use the wireless functionality on that device. It's connected to two Apple Airport Extremes via a Ethernet backbone supplying a seamless roaming wireless network across my fairly large home. I want to introduce a VPN router between the NBN modem/router and the Airport Expresses.

I see that ExpressVPN recommends purchasing a pre-configured router from Flashrouters to make life easy, and they suggest using a dual router setup just like I want. It's a great idea, but I'm unsure about warranty in Australia if I went down that path.

Also, as I already have a perfectly capable wireless network, I'm less concerned about the wireless capability of the VPN router. An article on the best router to use with DD-WRT with various VPN suppliers would be very helpful. I'm not afraid of flashing the device myself but a pre flashed device would be preferable.

Neil Macpherson

Ed replies: *Thanks for the suggestion Neil. We reviewed a handful of pre-configured VPN routers and also put together a guide to setting up DD-WRT back in late 2017 (see issue 448, pages 38-43) although we haven't specifically done a guide to setting up the VPN side of things. That's largely because it's a process that differs depending on the VPN provider you're using – and if we cover a specific one, the instructions we print in the mag will only be useful to a small number of readers. We'll take another look into the area, however, and see if there is some way to construct a more broad and agnostic guide to creating a DIY VPN router.*

NOTHING BUT PRAISE (WELL, ALMOST)

I really like *APC* magazine and although I'm not technically savvy I do like the idea of having some idea of tech developments. I would love to be gutsy enough to try some coding (you had a nice series on Python) and an alternative to Windows/Office, but I'm worried I'll stuff something up!

I also love your emphasis on privacy and consumer awareness. It would be great to see a list of apps that provide great services for no/reasonable permissions, as well as naming and shaming apps that are data-mining with ridiculous permissions. I'm never sure what they all mean, but I do know a torch app shouldn't require any network connection or access to my contacts! Maybe a 'love it and leave it' app column, with alternatives? I'm on Android, but I suppose you should include info for Apple lovers too! I love the monthly app suggestions.

Really appreciate the backup stuff too – one of these days I'll actually do it! (I'm on Windows 7.)

Lastly, I always see great subscription prices for Australians, but never an equivalent for those of us in New Zealand. I'd definitely try a 12-issue subscription for the same price that Aussies pay – any chance we may see that sometime?

Tessa

Ed replies: *Thanks for the kind words Tessa. We've coincidentally rounded up a selection of privacy-focused apps in this very issue (see page 48), covering a variety of different major uses.*

Regarding subscription offers for New Zealand, it's something we'd love to offer – and have looked into – but despite our seeming physical proximity, sending magazines across the pond significantly increases the costs of distribution. That means, if we were to offer the same subscription prices in NZ as AU, we'd be significantly in the red... and our publisher won't let us to give away copies of the mag any more (even to the nicest readers).

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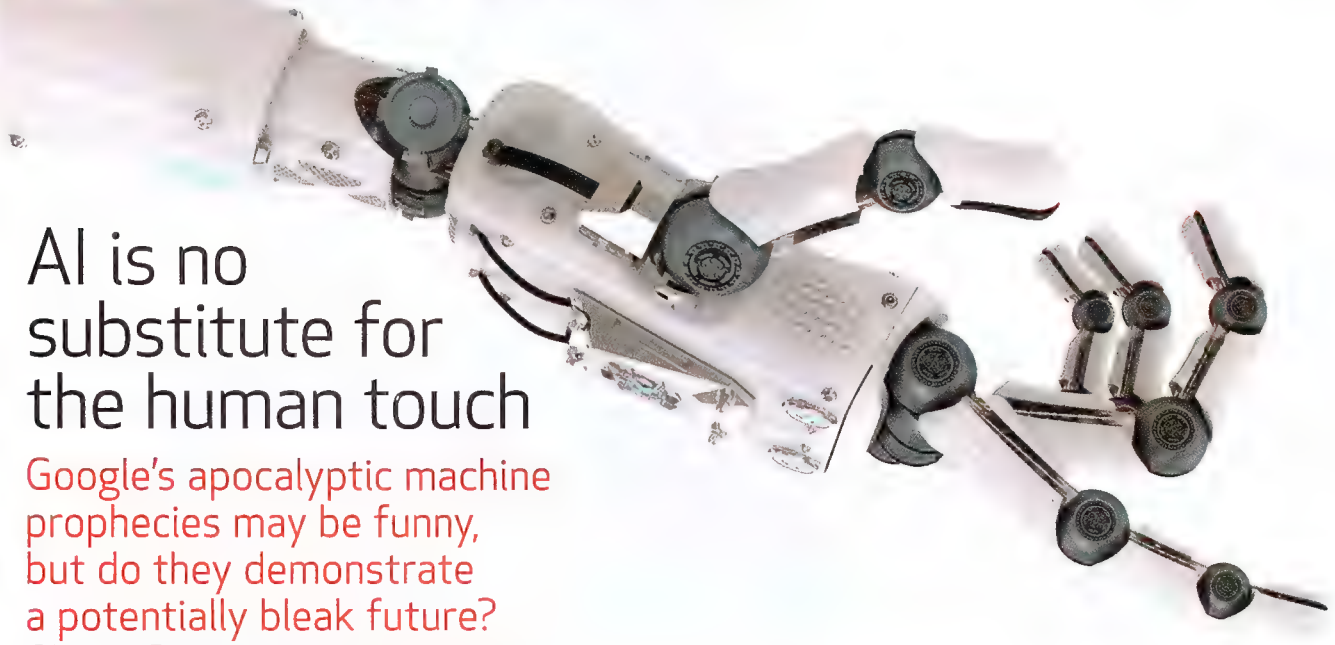
end user

» SHAUN PRESCOTT DIGS INTO THE BIG TECH ISSUES AFFECTING CONSUMERS



AI is no substitute for the human touch

Google's apocalyptic machine prophecies may be funny, but do they demonstrate a potentially bleak future? Shaun Prescott investigates.

Google Translate is a magical thing. Drag and drop any language into it, and it'll deliver a fairly accurate translation in the language of your choice. Except when it doesn't. A case in point: internet sleuths discovered in July of this year that typing 'dog' into the panel 22 times and then translating it to west African language Yoruba provided the following result: "Doomsday Clock is three minutes at twelve. We are experiencing characters and dramatic developments in the world, which indicate that we are increasingly approaching the end times and Jesus' return."

That's not the right translation, of course, and while it's tempting and fun to speculate that demons are responsible, it's more than likely a hiccup in Google's "neural machine translation" technology. That's according to a Harvard professor speaking to website Motherboard. Basically, the technology compares and contrasts the same texts in different languages and uses this data to help it translate. If the source text is, say, The Bible, but the Yoruba language lacks a good (or any) translation of that text, then things will inevitably go astray. But that's just one very broad example: when the system lacks the requisite data, it will seek to populate a response anyway.

"When you give [Google Translate] a new one it is trained to produce something, at all costs, that also looks like human language," Harvard professor Alexander Rush said. "However if you give it something very different, the best translation will be something still fluent, but not at all connected to the input."

This is an interesting example of automation and machine learning throwing up less-than-desirable results. In the case of what's been dubbed 'TranslateGate' it's mildly amusing. But the internet is increasingly marked by a vague eeriness born of systems. Take the case of 'Elsagate', a reddit-born conspiracy focused on the very-real ubiquity of seemingly algorithmically generated children's YouTube videos. Channels spit these videos out at an alarming rate based on popular tags. Elsa from Frozen is common, as are Spider-Man and the Joker. Generic assets are spliced together with no rhyme or reason, with these aforementioned characters often sharing the limelight together. To watch these videos is to marvel at a product virtually untouched by human warmth: they're cold, nonsensical, and fuelled by the logic of machine learning and SEO. They can often deviate dramatically from what most parents would regard as child-safe material, too.

These self-maintaining systems are no doubt efficient, but in the case of Elsagate, what's interesting is the proliferation of not algorithmically generated, but real human-created videos that have emerged that seek to ape the superficiality of the astoundingly-popular bot creations. In other words, the system fine-tunes a certain variety of logic, and then the human touch adapts to it. It's like something out of a cyberpunk novel.

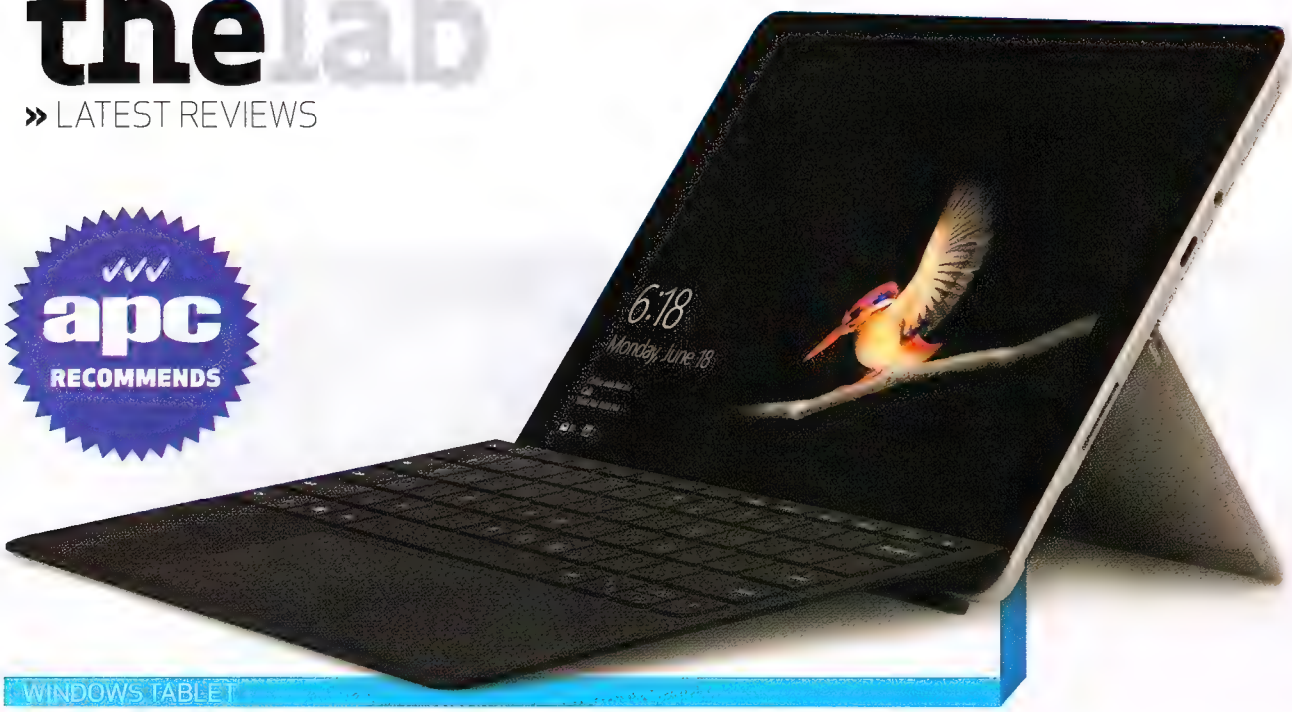
Our lives are increasingly driven by the advice of machines. Platforms like Amazon, Netflix and Steam all think they know enough about our tastes to offer suggestions for other things we'd like. These are innocuous, harmless enough. But TranslateGate and Elsagate both demonstrate the foibles of machines and the potential consequences of letting them run the show. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

apc RECOMMENDS



WINDOWS TABLET

FROM $599; $839 AS TESTED | WWW.MICROSOFT.COM/EN-AU

Microsoft Surface Go

Is this the Windows tablet that can finally tackle the iPad?

Microsoft's Surface Go, its latest tablet that aims to be a smaller and more affordable Surface Pro is finally here. The Surface Go doesn't bring about any major surprises, but perhaps that's a good thing.

What you see here is what should have been the core conceit of every small Windows tablet since the beginning: everything you love about the Surface Pro, only smaller. No half-baked operating systems – though this model does ship with Windows 10 in S Mode – and no strange app compatibility issues. It's just a smaller Surface that works.

Of course, there were some cuts to be made to create a Surface tablet of this size, namely in the power department, but your expectations should scale accordingly. Depending on your needs, the Surface Go could easily be your daily driver for everything from work to watching movies.

The configuration we reviewed (the most powerful version with 128GB eMMC of storage and 8GB of RAM) costs $839, and it's the most powerful version that Microsoft offers. Meanwhile, the starting model goes for $599, with 64GB of storage and 4GB of memory, while the rest of the specs remain the same. Annoyingly, Microsoft continues to sell the tablet's all-but-essential accessories separately. The Surface Pen goes for $139, while the new Alcantara fabric Type Covers designed for Surface Go ask for $199, or the standard black nylon Type Cover for $149.

DESIGN

At first glance, the Surface Go appears simply to be the Surface Pro shrunken down, and that's largely true – excellent kickstand and all.

The first major hint toward the Surface Go's intended audience is the rounding of the edges and angles that Microsoft has applied to the device. Gone are the stark, angled edges of the Surface Pro.

The excellent hinge returns and can bend nearly 180 degrees like before, making this device an ideal canvas for digital drawing and note taking.

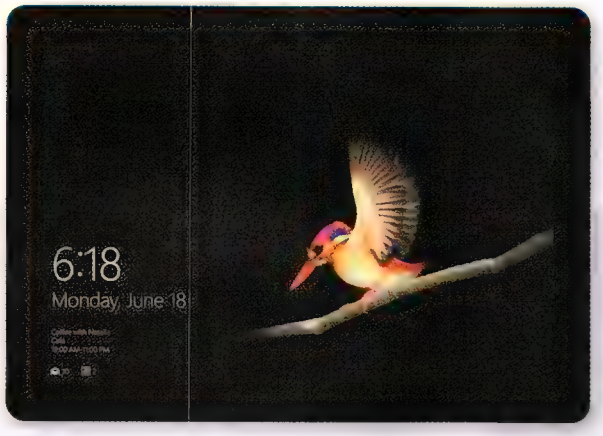
Microsoft still managed to cram a USB-C port and microSD card reader in here. This means that not only can this tablet's storage be expanded, but it has two ways to hardwire a dock and expand displays, thanks to the mainstay Surface Connect port.

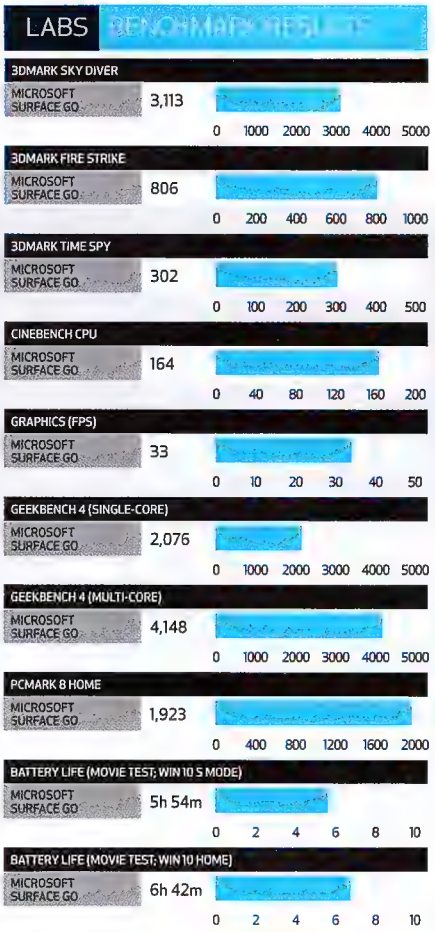
As for the new, smaller Type Cover, Microsoft manages to deliver full-sized keys (now with more pronounced curves) within a smaller amount of space, and has included a glass trackpad that's larger in depth than that of the Surface Pro. All told, the Type Cover feels just as snappy as it has before – we would say 'only smaller,' but it doesn't feel that much more cramped when typing. That said, you will need to get used to a slightly tighter typing experience, especially when the device is on your lap.

DISPLAY

Microsoft's screen continues to be top notch on the Surface Go. At 1,800 x 1,200

"The Go is just gorgeous in everyday use. The display is incredibly colour-accurate, and movies and images look fantastic on it."





pixels, it's not the sharpest 10-inch tablet display by a long shot, with the latest iPad coming in at 2,048 x 1,536 pixels. Regardless, the Go is just gorgeous in everyday use. The display is incredibly colour-accurate, and movies and images look fantastic on it. That 3:2 aspect ratio is great for work and web browsing, but gives full-screen 16:9 videos the shaft with wasted space.

Like most tablets, the bezels around the display are particularly large, but that's to allow for gripping the device from any side without interacting with any on-screen content.

The Go's speakers reside within those bezels on both sides of the screen. For such tiny drivers, these speakers sound surprisingly powerful, deep and nuanced in the amount of channel separation they can deliver.

Before getting too deep into details just yet, let's make it clear that you generally shouldn't buy a tablet or laptop for this price and expect a powerhouse. You'll get something competent enough to handle basic workloads and casual games, and the Surface Go does that, but not much more.

The Surface Go, with its Intel Pentium Gold processor, can handle basic browser-based workloads, like word processing and content management, as well as the suite of Office 365 apps, with ease. However, don't expect this processor to handle high-resolution image or video editing and rendering in the same way that a proper laptop does.

The CPU inside employs Intel's HD Graphics 615, which isn't far off from the integrated graphics inside the Intel processors used in gaming laptops. This allows for some surprisingly powerful 3D rendering, to the point that Minecraft runs like a dream on the tablet. Furthermore, education apps that use 3D modeling – particularly in the science field – run without issue here, as does Microsoft's Paint 3D tools.

The latest iPad ousts the Surface Go in pure speed tests, but the Surface Go is a far more versatile device – even in Windows 10 S Mode. Speaking of which, unless you'd like to keep your device on lockdown for security or simplicity reasons, just upgrade to Windows 10 Home for free once you get this device.

BATTERY LIFE

Microsoft promises up to nine hours of continuous use from the Surface Go. Shocking no one, those aren't the numbers we could reproduce in our testing, but they're not awful. What's weirder is how we've found the device to actually last longer in Windows 10 Home than in S Mode.

The difference in our tests is less than an hour, and at any rate, expect the Surface Go to last around six hours on a charge, and perhaps a bit longer if the Battery Saver feature is used.

The Surface Go may very well be a niche device, but it's one that's only growing. While you could reduce the Surface Go to being just a smaller Surface Pro, the truth of the matter is that the market is trending toward smaller and smaller computing devices.

Yes, there are still no accessories included, it's technically less powerful than the new iPad and that screen could be sharper. But this is still a compelling option, and one that's truly a computer in every sense of the word.

Joe Osborne

Verdict

Features ★★★★☆
Performance ★★★★☆
Value ★★★★☆

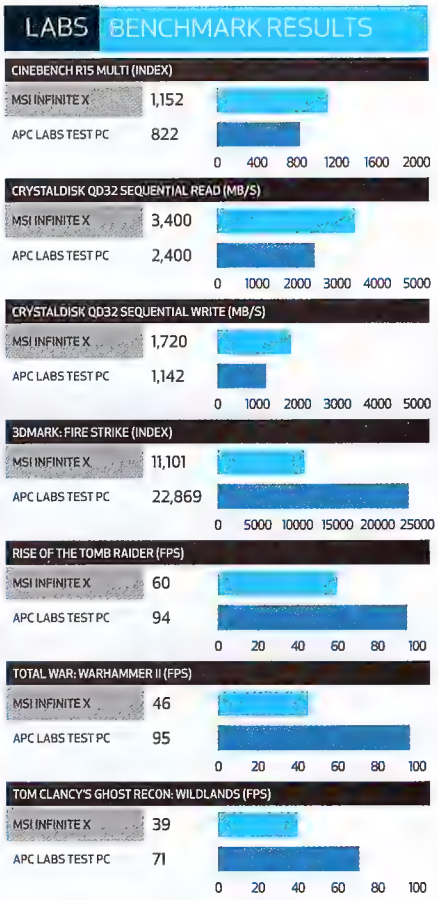
The Surface Go is a gorgeous machine that brings you an excellent Windows 10 experience in a 10-inch tablet.

★★★★☆

apc RECOMMENDS

DESKTOP PC

FROM $1,599; $3,099 AS TESTED | AU.MSI.COM


LABS BENCHMARK RESULTS
CINEBENCH R15 MULTI (INDEX)
MSI INFINITE X 1,152
APC LABS TEST PC 822
0 400 800 1200 1600 2000
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)
MSI INFINITE X 3,400
APC LABS TEST PC 2,400
0 1000 2000 3000 4000 5000
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)
MSI INFINITE X 1,720
APC LABS TEST PC 1,142
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3DMARK: FIRE STRIKE (INDEX)
MSI INFINITE X 11,101
APC LABS TEST PC 22,869
0 5000 10000 15000 20000 25000
RISE OF THE TOMB RAIDER (FPS)
MSI INFINITE X 60
APC LABS TEST PC 94
0 20 40 60 80 100
TOTAL WAR: WARHAMMER II (FPS)
MSI INFINITE X 46
APC LABS TEST PC 95
0 20 40 60 80 100
TOM CLANCY'S GHOST RECON: WILDLANDS (FPS)
MSI INFINITE X 39
APC LABS TEST PC 71
0 20 40 60 80 100

Our Labs test PC consists of an AMD Ryzen 5 1600, 16GB of Crucial Ballistix Sport LT @ 2666, an EVGA GeForce GTX 1060 3GB, and a 250GB Samsung 960 Evo M.2 PCIe SSD. All tests performed at 1080p at highest graphical profile.

MSI Infinite X

To infinity, and... actually, no, just to infinity.

Remember when buying a PC used to mean going to an actual store, walking around a long display of fascinating beige boxes adorned with functional jewelry, such as printers and desktop microphones, speaking to an overbearing man in a short-sleeved shirt, then waiting several days for a different man, this one less overbearing, to arrive, and put it together in your home? Modern system builders like MSI can't hope to replace the hand-drenching thrill of that 1990s experience, but they do bring a few bonuses of modernity to the table.

This Infinite X doesn't have an ounce of bloat on its spec sheet. Our test unit came with a GTX 1080 Ti, Core i7-8700K, and 16GB of RAM – although in AU, the nearest equivalent has a GTX 1080 and 32GB of RAM. Both are fairly close to the sweet spot for high-end gaming right now, before the laws of diminishing returns really kick in and render any further performance gains pointless in the wake of escalating cost. And together, those parts riped through our 1080p benchmarks with predictable vigour, although for 4K gaming at a stable 60fps, you'll need yet more firepower. MSI's own Z370M Gaming Pro AC motherboard provides the beating heart of the whole operation, while storage options ranging from SSD plus HDD to two M.2 SSDs are also available. So far, so good.

This being a high-end system, there's a fair amount of showboating going on with the case and componentry. The GPU is mounted vertically in line with side panel cutaways on the case, so you can see the 0dB fan technology in action and, like us, briefly panic that something's come loose inside and is frying your silicon. The option of a tempered glass side panel is there for those who want it, revealing a little more RGB flair. We'd hardly say our test sample was restrained, however: There's still an enormous backlit design on the front panel, and more sharp edges on the case as a whole than an Nvidia Founder's Edition blower. Shout out to the front panel full of handy ports: an HDMI for VR headsets, a USB-C for newer devices, two USB 2.0s, and one 3.0. They could have been implemented more elegantly, but that's perhaps in the eye of the beholder.

But there are a few case issues that go more than skin deep. The enormous power button is positioned in a hazardously easy-to-accidentally-nudge position, while the rear handle and DVD drive cover (yep, it actually has a physical media drive in 2018) feel worryingly flimsy.

Looking inside, it's clear that minor problems have reached there, too. MSI's system builders have obviously done the best job possible to create a neat and tidy, airflow-friendly rig, but there are a few cables dragged across the motherboard and remaining in plain sight as a result of the RGB LED fanciness going on at the front, and a slightly cramped interior.

But let's be clear: all our gripes so far extend only as far as the case, and when you're talking about a GTX 1080 system, that's small fry. The important thing is that performance is where we'd expect it to be, and the price is bang on the mark. With the GTX 2080 almost here, the whole bang-for-buck paradigm is about to shift dramatically, so this isn't the ideal time to invest in a new system. However, if you're really into the Infinite X's striking look, and want to blitz games at 1080p, this is an attractive prospect.

Phil Iwaniuk

Verdict

Features ★★★★½
Performance ★★★★½
Value ★★★★½

Blistering 1080p performance with adequate value, but the case isn't without its issues.

★★★★½

apc HOT PRODUCT

"ASUS claims that the ZenBook Flip S is the world's thinnest convertible, and it certainly feels it."

2-IN-1 LAPTOP

$1,999 | WWW.ASUS.COM/AU

ASUS ZenBook Flip S UX370UA

Asus sets the bar high with this versatile performer.

The ZenBook Flip S UX370 is a 2-in-1 with a good deal of performance, while keeping the base running speed low until it's needed. Beyond the hardware, the externals are pretty much the same – which is no bad thing, since the ZenBook Flip S is a joy to use.

This latest ZenBook Flip S isn't for the light of pocket. You're looking at roughly $1,999 for the model available in Australia: i5-8250U processor, 8GB RAM and 256GB SSD. For this review, we tested a higher-specced version with an i7-8550U, 16GB RAM and 512GB SSD. The UX370UA may be a tad more expensive than the cheapest 2-in-1s with these specs, but in our estimation it's also great value for money: sturdy, well designed with quality components, it also performs very well.

The standout feature, though,is its hinge, which brilliantly turns it from a standard Windows 10 laptop into a tablet, with various stages of usefulness in between.

The metallic finish picks up fingerprints alarmingly easily, mind you – if you're even vaguely fastidious about keeping it box-fresh, you'll have your work cut out. And you will want to touch it. A lot. It's beautiful to hold in any orientation, but particularly as a tablet, where you can cradle it easily in one hand while tapping away with the other. At 1.1kg it's certainly light enough, and the inclusion of a slip case means you can pop its svelte 13.3-inch form into any bag easily. Even the power brick is small enough to take along with you without much hassle.

ASUS claims that the ZenBook Flip S is the world's thinnest convertible, and at 10.9mm it certainly feels it. There's a slight downside in the fact that there isn't much room for ports, with only a pair of USB 3.1 Type-C slots present. There's also a volume rocker on the side, next to the power button, along with a fingerprint sensor – it's tiny, but is easy to find and works well.

We feared that the Flip S UX370's sleek design would make for an unpleasant keyboard experience, but this isn't the case. More surprisingly, the touchpad is perfectly usable, with the added advantage of a touchscreen, too.

Updating the ZenBook Flip S to use Intel's latest 8th-gen CPU is a welcome move, since it sees this svelte machine trade blows with the best new 2-in-1s.

Where the Flip S UX370 doesn't stun us is with its battery life. While it's not awful, it doesn't quite live up to its potential. You could happily carry this around all day, but you'll need to reach for a power socket at least once during that time. In our exacting PCMark 8 benchmark test it lasted just over 3 hours, although it lasted 6 in our HD movie test. Speaking of which, the screen is a particularly vibrant panel, with punchy colours and great viewing angles. The sound is good as well, with the Harman Kardon-certified speakers producing an above-average audio experience.

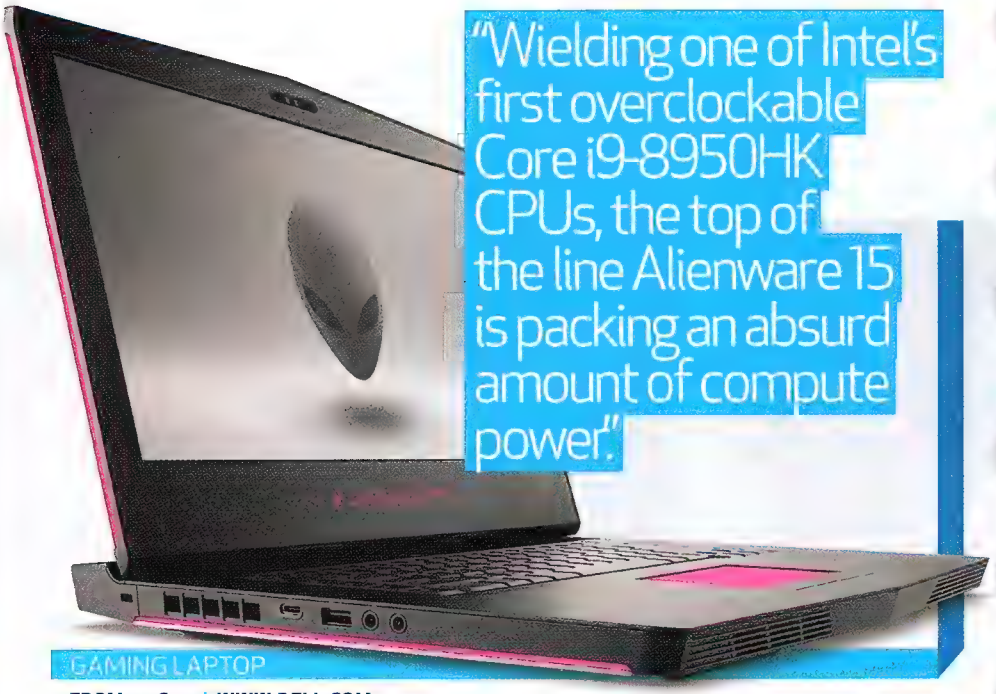
While not perfect, the ASUS ZenBook Flip S UX370 hits its core competency so brilliantly, its few imperfections are unimportant. ■

Verdict

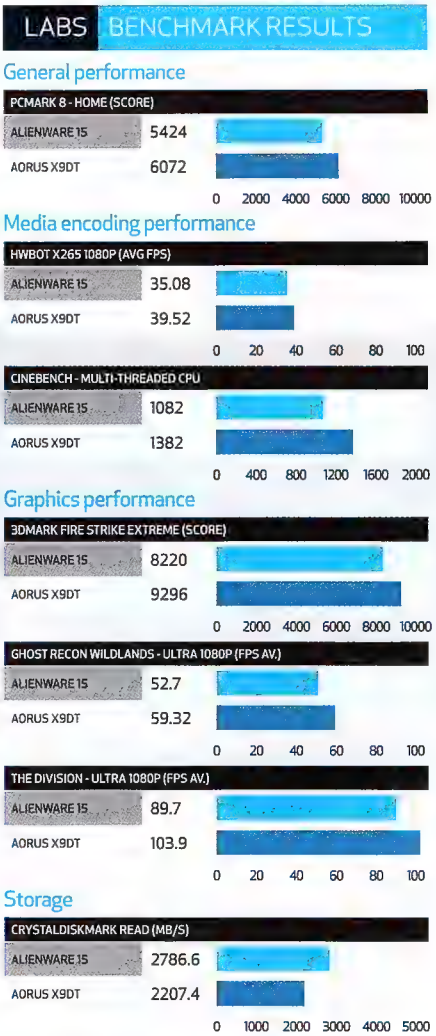
Features	★★★★★
Performance	★★★★★
Value	★★★★½

The Flip S UX370 is a light and powerful 2-in-1 that aims for perfection and almost gets there.

★★★★★


"Wielding one of Intel's first overclockable Core i9-8950HK CPUs, the top of the line Alienware 15 is packing an absurd amount of compute power."
GAMING LAPTOP

FROM $4,699 | WWW.DELL.COM


LABS BENCHMARK RESULTS
General performance
PCMARK 8 - HOME (SCORE)
ALIENWARE 15 5424
AORUS X9DT 6072
0 2000 4000 6000 8000 10000
Media encoding performance
HWBOT X265 1080P (AVG FPS)
ALIENWARE 15 35.08
AORUS X9DT 39.52
0 20 40 60 80 100
CINEBENCH - MULTI-THREADED CPU
ALIENWARE 15 1082
AORUS X9DT 1382
0 400 800 1200 1600 2000
Graphics performance
3DMARK FIRE STRIKE EXTREME (SCORE)
ALIENWARE 15 8220
AORUS X9DT 9296
0 2000 4000 6000 8000 10000
GHOST RECON WILDLANDS - ULTRA 1080P (FPS AV.)
ALIENWARE 15 52.7
AORUS X9DT 59.32
0 20 40 60 80 100
THE DIVISION - ULTRA 1080P (FPS AV.)
ALIENWARE 15 89.7
AORUS X9DT 103.9
0 20 40 60 80 100
Storage
CRYSTALDISKMARK READ (MB/S)
ALIENWARE 15 2786.6
AORUS X9DT 2207.4
0 1000 2000 3000 4000 5000

Alienware 15 R5

Can Dell deliver on the promise of an uncompromising 15-inch powerhouse gaming laptop?

Dell's matt-black Alienware 15 flagship gaming laptop is actually pretty unimposing to look at in person. It isn't quite as sleek as the 1.8cm thick ASUS ROG Zephyrus (see APC 445, page 24), but the extra 0.7cm thickness in the Alienware's chassis gives it space for bigger fans and larger heat sinks. This means it can technically be fitted with Intel's overclockable i9 CPU, but after getting our hands on a machine with that chip, we're not quite sure this laptop is cool enough to handle such a powerful CPU.

The Alienware 15 also only comes with a 60Hz display (a 15.6-inch IPS number at 1080p), which is a step down from some of the bigger, faster G-Sync panels that are at the forefront, such as on MSI's GT75 Titan (see APC 456, page 25) and the Aorus X9 DT (see APC 456, page 26). As with most of the Alienware 15's components, however, you can optionally upgrade the screen resolution to 4K, or swap to a 120Hz G-Sync panel – provided you're happy to add $200-300 to the final price tag.

Wielding one of Intel's first overclockable Core i9-8950HK CPUs, the top-of-the line Alienware 15 packs an absurd amount of compute power. This hexa-core CPU is complimented by a sufficiently beefy 16GB of RAM by default – add $390 if you want the 32GB model we tested. There's the same kind of pricing for storage; a 512GB PCIe M.2 SSD is included, but it's $120 or $1,475 extra for a 1TB HDD, or a 1TB HDD and double the PCIe SSD capacity, respectively. The included Class 40 SSD is fast, with read and write speeds of 2,786 and 1,355MB/s, but it's hard to imagine a primary gaming rig without additional storage.

The Alienware 15 gets expected PCMark 10 scores of 6,085 compared to 4,754 and 6,356 from the MSI GT75 Titan and Aorus X9 units, respectively. In Cinebench R15's multi-threaded CPU benchmark however, the Alienware 15 scores around 22% less than both these devices. While this didn't seem to affect general usem, we saw a similar performance dip in media encoding benchmarks, which we suspect is due to thermal throttling from the CPU's regular 100°C spikes.

3DMark Fire Strike Ultra scores sat at 4,266, which is about 7% better than the ASUS ROG Zephyrus and between 16% and 20% lower than the GT75 Titan and X9. This makes sense, given the Zephyrus also has a Max-Q GPU while the other two use regular mobile GTX 1080s. In real-world games like *Ghost Recon: Wildlands* and *Middle Earth: Shadow of War* you're looking at average frame rates of 52.7 fps and 89fps using Ultra 1080p settings.

The Alienware 15's customisability will be great for anyone who wants total control over their build, but if you add in the optional extras of 32GB of RAM, a fast screen and adequate storage space then the Alienware 15 ends up only $200 or so less than the $5,599 Aorus X9 DT. Considering the X9 DT has a faster screen, mechanical keyboard and double the PCIe SSD storage (a privilege that Dell charge $1,475 for) it's pretty clear which is the better value.

Joel Burgess

Verdict

Features	★★★★
Performance	★★★½
Value	★★★½

While there's a lot of premium parts to ogle, it's not the most balanced gaming rig we've seen from Alienware.

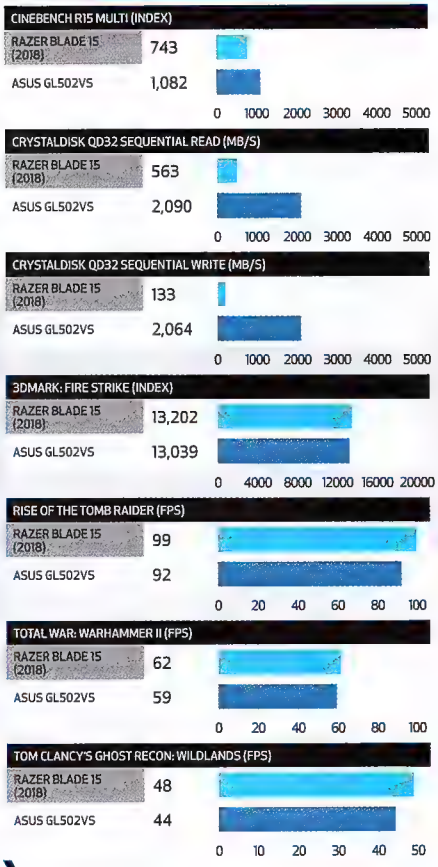
★★★½

apc RECOMMENDS

GAMING LAPTOP

FROM $2,899 | WWW.RAZER.COM

LABS BENCHMARK RESULTS


CINEBENCH R15 MULTI (INDEX)
RAZER BLADE 15 (2018) 743
ASUS GL502VS 1,082
0 1000 2000 3000 4000 5000
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)
RAZER BLADE 15 (2018) 563
ASUS GL502VS 2,090
0 1000 2000 3000 4000 5000
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)
RAZER BLADE 15 (2018) 133
ASUS GL502VS 2,064
0 1000 2000 3000 4000 5000
3DMARK: FIRE STRIKE (INDEX)
RAZER BLADE 15 (2018) 13,202
ASUS GL502VS 13,039
0 4000 8000 12000 16000 20000
RISE OF THE TOMB RAIDER (FPS)
RAZER BLADE 15 (2018) 99
ASUS GL502VS 92
0 20 40 60 80 100
TOTAL WAR: WARHAMMER II (FPS)
RAZER BLADE 15 (2018) 62
ASUS GL502VS 59
0 20 40 60 80 100
TOM CLANCY'S GHOST RECON: WILDLANDS (FPS)
RAZER BLADE 15 (2018) 48
ASUS GL502VS 44
0 10 20 30 40 50

Razer Blade 15 (2018)

Small, solid and strong.

Just over five years ago, Razer introduced the original Blade laptop. Compared to its contemporaries, it was minuscule, but gaming laptops have slimmed down since, culminating in the Max-Q design seen in the best laptops of the last year or so.

With the Blade 15, Razer has caught up with the competition in terms of what makes a great gaming laptop. Solid build, slim body, elegant design, long battery life, thin bezels, 144Hz screen, and internals powerful enough to play the latest games. That means an Intel Core i7-8750H paired with an Nvidia GeForce GTX 1070 Max-Q.

What sets the Blade 15 apart is the details. Its aluminium body is the most solid and flex-resistant of all the laptops we've tested lately, and it's the thinnest, too, by about half a millimetre. More impressive is the overall solid feel of the body, which Razer says is CNC-milled from a single block of aluminium.

Opening it up, the touchpad is larger than its peers, and the keyboard is flanked by large speakers.

The keyboard, however, gave us a few problems. The keys feel good to press, for both typing and gaming; our problem came with the layout which, in addition to missing a number pad (forgivable, considering the space constraints), repositions the up-arrow key between right-shift and forward-slash. If you're used to this setup for question marks, prepare to mess that up. Our other issue is with the touchpad —its large size caused us to accidentally tap it while typing.

Despite a slightly thinner design than its peers, the Blade 15 performs better in our gaming benchmarks. It averaged 92fps across *Rise of the Tomb Raider*'s three-part benchmark, managing 144fps in the Mountain Pass, 83fps in Syria, and 78fps in the Geothermal Valley. That's much closer to the lab's favourite Asus GL502VS laptop's 99fps (powered by a standard GTX 1070) in *RotTR*, compared to the mid-80s scores of the GS65 and Gigabyte's Aero 15X. *Total War: Warhammer II* and *Ghost Recon: Wildlands* produced scores either in line with or a slight step up from the GS65 and Aero 15X — 59 and 44fps respectively — though the difference was more in the realm of 3 - 4 frames, instead of 10-plus.

The Blade pulls those scores off thanks to a vapour chamber cooling solution connected to the CPU and GPU. It keeps the internals from throttling under extended load, and stops the outside of the Blade getting too hot to handle during extended gaming sessions. After a lengthy stress test, we measured temperatures of around 54°C at the hottest points — above the keyboard — but the area around the WASD keys remained in the realm of 38°C.

The Razer Blade 15 delivers absolutely everything we want in a gaming laptop, in one of the best-designed bodies we've ever seen. The build quality is top-notch, and gaming performance matches. The downside, of course, is its price. The Blade 15 starts at $2,899, but that's for a GTX 1060 Max-Q GPU and a 60Hz screen. The GTX 1070 Max-Q models, like the one we tested here, start at $3,699, with more expensive options if you want a larger SSD or a 4K panel. The Blade is probably the best-looking gaming laptop we've ever tested, but near-identical performance can be had from MSI's GS65 Stealth for a few hundred dollars cheaper. So, choose your weapon wisely.

Bo Moore

Verdict

Features ★★★★½
Performance ★★★★½
Value ★★★½

Exceptional build quality; thin and light; great performance. But no Ethernet port and the keyboard layout is awkward.

★★★★☆

CHROMEBOOK

$559 | WWW.ACER.COM

Acer Chromebook Spin 11

Acer spins out a winning ChromeOS machine

Chromebooks have generally been regarded as lower-end cheap laptops, fit for education and casual web-browsing. However, in a post-Pixelbook world, do they still fill the same role? Well, the Acer Chromebook Spin 11 proves, they can.

It's designed to appeal to parents with young children needing a laptop for schoolwork, but it's also suitable for someone who wants to install Linux. It's durable, has decent enough performance, comes with an included stylus and carrying case, and it's inexpensive.

Only one configuration's available – an Intel Celeron Quad Core N3450 CPU with 4GB RAM and a 32GB SSD – selling for $559.

The Spin 11 features an all-plastic build, but don't let that deceive you as this Chromebook is one of the sturdiest laptops we've ever used. No matter how hard we tried. On paper, the keyboard would also seem shallow with just 1.1mm of key travel, but it feels comfortable and we didn't feel the keys bottoming out at all while working on it.

It's not the lightest Chromebook in the shop, weighing in at 1.35kg. However, its thin 2cm frame with rounded corners makes it pleasant enough to hold, and we're sure that it was difficult to make it much lighter without giving up some of the durability. Ports are also a huge win here, with two USB-C ports, which handle data transfer and charging. In a Chromebook at this price range, we would have been happy with just one. You've also got two USB 3.0 ports, a microSD card slot and a headphone jack.

The screen also reflects (if you'll excuse the non-pun) the durable nature of the Chromebook, as it's covered by Corning Gorilla Glass. So it should be resistant to cracking or shattering. The touchpad is a sour point, however. The surface is competent, but it's extremely sensitive, not to mention that the plastic finish and tough centre-click was a turn-off. However, it does support gestures, so it's not all bad.

Things start to take a turn when you look at the display. It sports a 1,366x768 IPS display, and while viewing angles are good, it's not very bright.

The speakers, also, are a bit lacklustre; while they do manage to fill the room, there's not all that much in the way of detail in the sound. The Spin 11 is fine for watching YouTube videos; just don't expect a pleasant experience while listening to music or watching 'real' films.

Even with modest components, Chrome OS continues to prove itself competent for its intended use cases: web browsing and word processing.

While it won't be able to keep up with something like the Google Pixelbook, the Acer was able to keep up with a decent workload: typing this review with 10 tabs open in Chrome and a music player running in the background. Honestly, that's exactly what we wanted to see.

However, one of the most important aspects of a Chromebook is its battery life, and unfortunately the Spin 11 disappointed here. When we looped a local video at 1080p running in VLC, the device died after just 7 hours and 34 minutes.

For a Chromebook, this is well below the category average. For instance, the similarly configured (and older) Dell Chromebook 13 scored almost double when running the same test, at around 14 hours.

Overall, the Acer falls in line with similar devices, but when you consider the included stylus and carrying case, it looks like a bargain.

Bill Thomas

Verdict

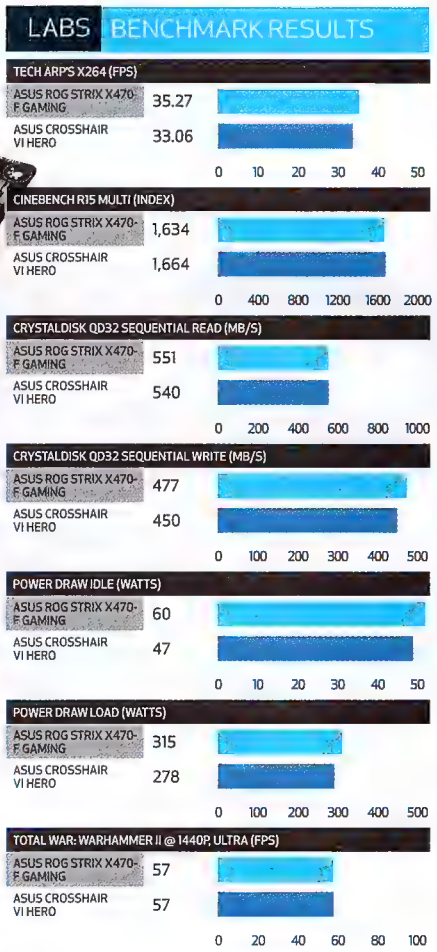
Features	★★★★
Performance	★★★½
Value	★★★★

Works great as a cheap laptop for school or general browsing, but beware its comparatively low battery life.

★★★★☆

AMD MOTHERBOARD

$319 | WWW.ASUS.COM/AU


LABS BENCHMARK RESULTS
TECH ARP'S X264 (FPS)
ASUS ROG STRIX X470-F GAMING 35.27
ASUS CROSSHAIR VI HERO 33.06
0 10 20 30 40 50
CINEBENCH R15 MULTI (INDEX)
ASUS ROG STRIX X470-F GAMING 1,634
ASUS CROSSHAIR VI HERO 1,664
0 400 800 1200 1600 2000
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)
ASUS ROG STRIX X470-F GAMING 551
ASUS CROSSHAIR VI HERO 540
0 200 400 600 800 1000
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)
ASUS ROG STRIX X470-F GAMING 477
ASUS CROSSHAIR VI HERO 450
0 100 200 300 400 500
POWER DRAW IDLE (WATTS)
ASUS ROG STRIX X470-F GAMING 60
ASUS CROSSHAIR VI HERO 47
0 10 20 30 40 50
POWER DRAW LOAD (WATTS)
ASUS ROG STRIX X470-F GAMING 315
ASUS CROSSHAIR VI HERO 278
0 100 200 300 400 500
TOTAL WAR: WARHAMMER II @ 1440P, ULTRA (FPS)
ASUS ROG STRIX X470-F GAMING 57
ASUS CROSSHAIR VI HERO 57
0 20 40 60 80 100

ASUS ROG Strix X470-F Gaming

A gaming 'board with stealth mode engaged.

Why, Asus? Why? We want to be kind to your products, honest we do, but with the current lack of innovation across your mid-range motherboard arsenal, it forces us into an unhappy position.

What's the problem? Well, it's a simple one, but it comes down to what can only be described as the ROG tax. Right now, the X470-F is available for a rather high-ish $319. Aesthetically, it's a pleasing AM4, ATX motherboard, complete with flashy RGB heatsink, swappable chipset stickers, and a fully specced out complement of connectivity for all your devices. It really ought to be —after all, it's broken that $300 mark, and it's not what we'd consider affordable. The problem lies with a product within Asus's own arsenal. Namely the ASUS Prime X470-Pro, which is about $30 cheaper.

Side by side, the PCB layouts are almost identical. Power phases, capacitors, traces, fan headers, SATA ports, PCIe slots — you get the picture. Even the rear I/O is the same. The only differences being that the Prime lacks an additional RGB header, and it doesn't have quite as beefy an audio solution as the ROG.

So, why buy the ROG? That's a good question and that decision mostly comes down to aesthetics. Do you like the darker styling, the rear I/O plate being pre-installed, and the I/O cover being somewhat larger than that of the Prime? If so, perhaps the ROG is the choice for you, but we're not convinced. After all, you can pick up an older X370 Crosshair VI for $40 less, and apart from the better power solution, improved audio hardware, and expanded connectivity, it also has that splendid styling. It's a far superior motherboard, though you'll need to perform a BIOS update to get it to work with the latest Ryzen 2 series.

But enough railing — how does it do in our tests? All in all, it's pretty impressive. We saw excellent scores in both Tech ARP's X264 test and the Fry Render benchmarks. Latency was far better than the other boards we've seen so far, no doubt thanks to a newer BIOS, and CrystalDisk sequentials also performed solidly, too. Unfortunately, there's still no change on the overclocking front, and the lowest voltage we managed at 4.0GHz was 1.41V, placing it slightly worse than the Crosshair VI Hero.

Power draw is something of a problem, though, and is arguably what contributed to the high scores in both TechARP's X264 and Fry Render, because under load it drew 315W from the wall.

So, the price shenanigans aside, it's a fairly well-rounded board. Yeah, it's a bit heavy on the old power draw, but ultimately it performs well, is consistent, and admittedly does look seriously good. The RGB lighting is subtle and isolated, and being able to swap out chipset stickers although a bit gimmicky, is admittedly a neat addition.

That said, if you want the performance, we recommend the Prime X470-Pro; if you want the looks, you could grab the ROG, although a Crosshair VI would likely serve you better. ■ **Zak Storey**

Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★½

Impressive performance, with a strong BIOS and great looks, with price and power draw the main negatives.

★★★½

apc RECOMMENDS

"The MPG27CQ arrives slap bang into the sweet spot in PC gaming monitors."

27-INCH GAMING MONITOR

$699 | AU.MSI.COM

MSI Optix MPG27CQ

A VA panel living in an IPS world...

Picture a PC monitor. with high refresh rates, low response times, snazzy styling, and RGB mood lighting. Looks a lot like a new ROG gaming monitor from ASUS, right? Indeed it does, but it also describes MSI's new Optix MPG27CQ.

The MPG27CQ arrives slap bang into the sweet spot in PC gaming monitors. It's a 27-inch panel with 1440p pixel grid. That makes for a very nice compromise between visual detail and smooth gaming. 4K gaming, after all, is a nice idea, but even the very latest and greatest graphics cards can't drive all those pixels at the triple-digit frame rates required for seriously slick and smooth gameplay. Meanwhile, if you stretch 1440p beyond 27 inches, the result is increasingly big, fat, and fugly pixels.

A basic model with a cheap TN panel limited to 60Hz refresh isn't exactly the stuff of gaming fantasy. Instead, what you want is something with a quality LCD panel, support for 120Hz-plus refresh, low latency, fast response times, and maybe some adaptive sync capability. What you want is something like the Optix MPG27CQ.

To the 2560x1440, 27-inch sweet spot, the MPG27CQ adds a long list of gaming-friendly features, including 144Hz refresh, 1ms response with user configurable overdrive and anti-blur, a low-input lag mode, support for AMD's FreeSync technology, and a gentle 1800R panel curvature thrown in for good measure. But that's not all. You also get some funky styling, including RGB LED mood lighting.

The net result is more than a little reminiscent of ASUS's ROG gaming monitors, albeit without quite the same level of polish and pizzazz. But where the MPG27CQ differs from the PC gaming norm is by virtue of its LCD panel. MSI has used VA technology. That's not unheard of amongst premium PC monitors;VA offers significantly better colours and viewing angles compared to TN panels, and superior contrast to IPS technology. The problem is that VA doesn't exactly have a world-beating reputation when it comes to pixel response. Certainly, it isn't the obvious choice for a gaming monitor.

However, it's clear that the MPG27CQ is defined by its VA panel. On the upside, the colours pop and the benefits of the 3,000:1 contrast ratio are undeniable: deep blacks that even the best IPS monitors can't match. The downsides begin with the warm, oversaturated colour balance that's a hallmark of most VA screens.

For gaming, that's no biggie. More of a concern is the pixel response. MSI has fitted the MPG27CQ with a snazzy OSD menu, with lots of gaming-centric features, including user-configurable pixel response. The fastest mode introduces noticeable inverse ghosting as a consequence of what must be very aggressive pixel overdrive. It also forces on MSI's anti-blur mode, which limits the backlighting to 50%. While the result is improved response and reduced blurring, the costs are too high. Even the middle of the three settings comes with an inverse ghosting trade-off.

The sense is of MSI trying to hammer a square VA panel peg into a round PC gaming hole. That doesn't stop the MPG27CQ from being a nice display, but it does compromise its ability to fully deliver on its premium gaming panel remit. ■ **Jeremy Laird**

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

Superb feature set, nice styling, bold colours and contrast but with flawed pixel response.

★★★★½

apc RECOMMENDS

GAMING MONITOR

$3,499 | WWW.ASUS.COM/AU

ASUS ROG Swift PG27UQ

This feature-packed gaming monitor is perhaps a bit *too* ahead of its time.

ASUS definitely isn't a company that's afraid to slap extremely high prices on premium gaming products, and the new ASUS ROG Swift PG27UQ is a prime example of this approach. But can the company justify the whopping price tag of $3,499 for a monitor that is only 27 inches across? Apparently they think they can, but we think that's a bit of a stretch, even considering the impressive features included.

There are two primary reasons for this high price. Firstly, it's a High Dynamic Range (HDR) display, which displays a much wider colour gamut than a standard monitor. There are multiple variants of HDR standards on the market, and the PG27UQ uses the most common, HDR10. This uses the Rec. 2020 colour space with 10-bits of colour information. It's not quite as good as HDR10+ though, which allows for the brightness of the screen to change per frame, whereas HDR10 only adjusts brightness of overall scenes. This is why HD10+ is now starting to become the dominant standard on premium TV sets.

Behind the LED screen are 384 different lighting zones, allowing for impressive light control compared to traditional edge-lit LED screens. While most HDR screens use OLED technology, ASUS has had to use an LED screen to deliver the super-fast refresh rate of 144Hz. We noticed very little light bleed as a result, and impressive contrast performance, with excellent detail in darker areas. It also uses Samsung's Quantum Dot technology to deliver its HDR capabilities and a claimed 97% of the DCI-P3 and 99% of the Adobe RGB colour spectrums. Unfortunately our X-Rite colorimeter measured much lower DCI-P3 performance, but it's not the fault of the display – our affordable colorimeter simply isn't accurate enough to deliver accurate results. According to ASUS' comments to **www.pcper.com** during their review, it requires a much more expensive industry-level colorimeter, such as the Klein K-10A, which retails for around $9,000.

With a resolution of 3,840 x 2,160, you're going to need some serious GPU hardware to power games at this resolution at the available refresh rates – we're talking triple SLI setups, even though Nvidia doesn't officially support these anymore. We were limited to testing with an ASUS GeForce GTX 1080 Ti, which struggled to hit anything over 90fps when HDR was enabled in games that supported it, such as *Battlefield 1*, and even then we had to use medium settings. Thankfully the inclusion of G-Sync support means it's possible to run games at lower refresh rates while retaining a smooth sensation of gameplay, but that then negates the benefit of the 144Hz refresh rate.

If money is no obstacle, the PG27UQ is undoubtedly the king of all gaming monitors. However, we think it's a product that is ahead of its time; there are only 50 or so HDR-enable games available now or coming in the near future, and the GPU power required to make the most of the high resolution combined with high refresh rates simply doesn't exist in anything less than multiple GPU setups. Still, if you want the best of the best, the PG27UQ is it.

Bennett Ring

Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★½

Pity there isn't enough gaming HDR content, or the silicon horsepower needed, to relish this great monitor...

★★★★½

"Even in bright conditions it can produce a display of around 100 inches in a modest-sized room, though this can stretch to a whopping 300 inches in larger rooms."

DLP PROJECTOR

$2,199 | WWW.BENQ.COM

BenQ TK800

Delivers a big-screen 4K experience on a (relatively) modest budget.

It was like the gods of fate had swept us up into their arms and tenderly kissed our foreheads when BenQ's TK800 True 4K HDR projector arrived just in time for this year's FIFA World Cup. With this fairly compact, sleek-looking unit in place and fired up, we were able to witness every drop of sweat dripped and every bit of spit gobbed in stunning ultra-HD detail.

The TK800 is a recent addition to BenQ's range of home entertainment projectors that are geared towards sports and is similar, in terms of design, to previous models. The big difference is the bright blue fascia.

On the rear of the unit are two HDMI ports (one of which is HDCP 2.2), 3.5mm audio jacks (in and out), RS-232, a USB-A and mini-B USB port,12V trigger port and VGA – although the latter is slightly redundant as it doesn't support 4K. Removing VGA in favour of another HDMI 2.2 port would have been the best option as it would have allowed more 4K-compatible devices to be connected at the same time.

The TK800 can be used as a front or rear projector and is equally at home placed on a table as it is mounted to the ceiling. Even in bright conditions it can produce a display of around 100 inches in a modest-sized room, though this can stretch to a whopping 300 inches in larger rooms.

So what is the quality like? Actually pretty damn good, even if the 4K it claims to produce is achieved via pixel shifting (when the system moves the sensor half a pixel's width to 'double' the apparent resolution by creating overlapping data in successive frames) rather than a natural 3,840 x 2,160-pixel resolution. This is made possible by Texas Instruments' 0.470-inch DMD XPR 1,920 x 1,080-pixel DLP chip that flashes four times in quick succession to produce an image that fools the eye into seeing 8.3 million pixels on screen at one time. Admittedly, the difference is very hard to spot, but stack this next to a proper 4K Digital Light Processing projector and you'll notice a slight downgrade in the ultra-fine details. Not that we're bothered by this as the price difference between the two would be colossal.

Focus and zoom on the TK800 are entirely manual, and the lack of lens shift means that the correct setup is vital to get the best out of it. Bafflingly, Auto Keystone is enabled by default which diminishes the fine detail, so make sure you deactivate this for the best viewing results. That said, as this is being marketed as a bit of a party piece as opposed to a serious home cinema projector (and is designed to project onto a white wall or hung bedsheet), it is hard to get too hung up about the really fine detail.

We can certainly vouch for it in delivering sport in stunning detail at a decent magnification and its budget price point (trust us, it is for a 4K projector) also makes it perfect from a professional point of view to showcase your Keynote presentations in well-lit conference rooms.

The TK800 also comes with a backlit remote control (which is obviously a roll-out across numerous BenQ projectors, as it features buttons for functions not present here) and is very easy to set up. Recommended for a wide range of uses. ■

Verdict

Features	★★★★½
Performance	★★★★★
Value	★★★★½

It may not be strictly 4K, but for the price it produces stunning detail and clarity for a wide range of purposes..

★★★★½

TV & GAME STREAMING DEVICE

REMOTE ONLY, $250; REMOTE AND GAMEPAD, $330 | WWW.NVIDIA.COM

Nvidia Shield TV (2017)

It's taken a long time to reach Australia, but is this finally the one media- and game-streaming device to rule your lounge room?

Nvidia's Android TV-powered Shield TV box may initially seem more suited as a device for those with older tellies with app deficiencies, although with 4K video output and built-in Google Cast capabilities, it can act like a supercharged Chromecast Ultra too – with a ton of extra features. Powered by Nvidia's own Tegra X1 processor – the same one used in the Nintendo Switch – it's also got lots of grunt for both media and game streaming, and powering Android-native games and apps, too.

The Shield TV comes in two options in Australia – a media-minded kit with just the box and a TV remote, or one pitched at gamers, that adds an Nvidia-built gamepad.

That remote is simple but serviceable and the Shield's interface is clean and straightforward, with a series of rows for different apps or services – such as Netflix, YouTube, Games and Google Play Movies/Music – which can be customised to a certain extent. Navigating and finding things is quick and easy, and thanks to voice search, you can press the remote's Mic button to locate things more rapidly or find specific media content – say "Post-apocalyptic movies", for example, and it'll give you a list of flicks available on Australian streaming services and local video sources. That 'local video sources' area is also well catered to thanks to a built-in Plex server and player, so you can attach a USB hard drive with your personal video collection and get a polished, Netflix-like interface for navigating through them.

The Shield TV isn't quite perfect when it comes to media playback though – at least not in Australia – as several major video-streaming apps aren't available for Android TV. While Netflix, Stan and Amazon Prime Video are all there (as well as Tenplay and 7plus for catch-up TV), at the time of testing, ABC iView, SBS On Demand and Foxtel Now apps weren't Shield compatible, so if you use these services, you'll need to rely on casting from your phone or tablet.

Being able to stream games from your PC is the Shield's other major drawcard, with one slight caveat – you'll need to BYO PC or laptop with an Nvidia GeForce GTX 750 or better GPU. You'll also want a wired (or strong Wi-Fi) connection between the two devices. If you pass those hurdles, you can stream basically any game from your PC to the Shield hooked up to your TV. All the processing happens in your computer, with the Shield merely streaming everything back and forth. Titanfall 2, running from a GeForce GTX 1080 over Wi-Fi was near flawless, with barely perceptible input lag between gamepad and onscreen action.

Android gaming's also possible, though the quality of the games – in terms of both their gameplay and technical measure – varies a lot, and not all Android games are compatible. The marvellous XCOM is off limits, but GTA: Chinatown Wars is fine. Nvidia's controller is the classic Xbox scheme, and it's a beauty of a gamepad.

If you see yourself using the game-streaming capabilities extensively and/or you're a mad-keen media streamer who doesn't like their TV's own interface then the Shield TV is a classy and fairly-priced box for what it offers.

Dan Gardiner & Paul Taylor

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

Justifies its higher price with great hardware and unique features, but you'll need to use them all to make it worth it.

★★★★☆

MOUSE

$55 | WWW.MICROSOFT.COM

Microsoft Classic IntelliMouse

The cult classic mouse is back — and it's even better than ever.

One of the most well-loved devices made by Microsoft during the late 1990s and early 2000s was the IntelliMouse, and now the company has revisited the iconic brand with the Classic IntelliMouse, which – according to Microsoft – is inspired by the IntelliMouse 3.0.

As our devices become ever more complex and convoluted (as well as delicate), there is a lot to be said about older hardware that's solidly built and does the job without fuss. Chunky and 'retro' designs can also help. It's this nostalgia and goodwill that Microsoft appears to be targeting with the Classic IntelliMouse.

You can clearly see the inspiration, with a similar ergonomic shape and black-and-grey design. For many people, this will be a case of 'if it's not broke, don't fix it', but if you were immune to the charms of the IntelliMouse the first time round, you may feel equally unimpressed here.

Fans of weird-looking ergonomic mice, or gaming-orientated pointers that pack in loads of buttons and glorious RGB lighting, will also wonder what all the fuss is about. Sure, there is some lighting, with the iconic red light of the original IntelliMouse now replaced with a modern white light.

It also has a decent number of buttons, five in total, with three that are customisable.

It's also wired, meaning you don't get the freedom of a wireless mouse, but you also don't have to worry about running out of battery at inopportune moments. It also means the mouse is lighter than wireless mice, weighing in at 100g.

Its compact body fits neatly in the hand, showing that Microsoft still knows a thing or two about designing ergonomic peripherals. The Classic IntelliMouse uses a USB 2.0 connection, and as you'd expect from a Microsoft peripheral, setting it up in Windows 10 is simple.

Configuring the extra buttons is straightforward, and can be done when using Windows 10, Windows 8.1, Windows 8 and Windows 7. Frustratingly, the option to configure those buttons isn't available in Windows 10 S.

Also, despite this being a Microsoft mouse, you need to download additional software to configure it – the Microsoft Mouse and Keyboard Center.

Despite its retro looks, the mouse includes some pretty modern features, giving it a level of performance that the original IntelliMouse lineup could only dream of. It has a 1,000 reports-per-second report rate, which makes it feel fast and responsive.

It also includes Microsoft's BlueTrack technology, which has been designed to allow the Classic IntelliMouse to work on almost any surface, no matter how reflective it might be. In use, the Classic IntelliMouse had no issues working on a range of surfaces, including a desk and carpet.

Overall, were very impressed with the performance of the Classic IntelliMouse. If you're after a dependably performing wired mouse, with some decent customisation options, then you'll be very pleased with this.

With the Classic IntelliMouse, Microsoft has a mouse that is both familiar and modern, offering the ergonomic comfort and dependability that IntelliMouse devices are known for. The design retains the iconic look, while also modernising it. Best of all, Microsoft is asking a reasonable price for it. It isn't just a retro collectible for people who wish we still had beige PCs and CRT monitors, but an excellent mouse that does the job very well. ■

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

The Microsoft Classic IntelliMouse is a very successful reinvention of the iconic mouse.

★★★★½

apc RECOMMENDS

GAMING KEYBOARD

$339.95 | WWW.RAZER.COM

Razer Huntsman Elite

Forget those rusty old mechanical switches; what you need is *optical* ones...

Circuit-based actuation has been considered the gold standard in gaming keyboards for some time now, but Razer believes it has an even better key switch that could revolutionise the market. Taking the best bits of the mechanical switch and blending it with a new optical sensor, Razer's secret weapon is a hybrid 'opto-mechanical' switch. While the tech's not exclusive to Razer, the company is one of the first to market with the hybrid switches, which appear o n it's new Huntsman Elite flagship keyboard.

The headline feature of these new switches is that they're supposedly 30% faster than traditional mechanical switches, using infrared light beams to trigger keystrokes and allowing virtually instantaneous response times, which considerably outpace the contact-based electrical circuit mechanisms in traditional mechanical keyboards. They're combined with new Razer-made 'purple' keys that are supposedly more durable, containing fewer moving parts and, therefore, reducing the opportunity for malfunction through wear. Razer claims this amounts to durability ratings of 100 million keystrokes, effectively doubling that of most mechanical keys. You might be sceptical about durability if you've kept up with the news of Apple's increased malfunction rate on it's optically-triggered butterfly switches, but Razer's reps assure us that its purple switches are encased in a fully dust-proof enclosure, making it impervious to interference from dust.

The new opto-mechanical switches have an actuation force of 45g and a travel distance of 1.5mm, making them most similar to a Cherry MX Silver switch at 45g actuation force and 1.2mm trigger travel. This tuning makes them exceptionally responsive and comfortable to type on, but still offers the kind of feedback you'd expect from a heavyweight 'clicky' gaming keyboard.

The Huntsman Elite is a full sized frameless keyboard complete with numpad, dedicated media controls and a detachable palm rest. Razer has taken a leaf out of Logitech's book by adding a scrollable volume wheel in the top right-hand corner, alongside three other dedicated media controls. You can switch to different gaming profiles using the 12 function keys across the top of the device, but there are no dedicated macro buttons or USB passthrough sockets. The streamlined facade is rather subdued for a gaming keyboard and it wouldn't feel out of place in an office setting – at least until you turn its lights on. It wouldn't be an 'elite' gaming keyboard without per-key RGB lighting, but Razer has taken this a step further by skirting the entire edge of the 'board with downward-firing LED lighting that's even integrated into the palm rest.

Price is the Huntsman Elite's main shortcoming: at $340, it's one of the most expensive gaming 'boards in Australia. If you're open to ditching the palm rest and media controls then you can bag this new set of switches on the standard Huntsman for around $250. Other than the price and a media control wheel (which we feel could do with some WD40), there isn't much to complain about, so if you're keen on the keys to the future of gaming keyboards, then this is a solid bet.

■ Joel Burgess

Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★½

If you demand ultimate key performance and have the cash then the Huntsman Elite is a keyboard you'll want to keep.

★★★★½

PC CASE

$219 | WWW.THERMALTAKE.COM.AU

Thermaltake View 37

A case to show off your building skills.

Where some manufacturers focus on premium materials or ever-smaller form factors for their latest cases, Thermaltake has decided to pursue a different course. Boasting a windowed, gull-wing side panel that curves around to cover the top of the case, this is a chassis that's brilliant at showing off the internals of your pride and joy.

The gull-wing side panel is the main selling point of this case, and its design requires some careful considerations, because you're essentially losing the side brace from the top to make way for the perspex panel. Strip the case down, and there's obvious flexing due to the shift in structural integrity. It isn't as noticeable with the side panels present, but it's there, and has forced Thermaltake to use a corner brace to help keep the panel in place and the flexing to a minimum. It also means that it isn't the tool-free design that it was originally intended to be – you'll need a screwdriver for the four screws holding this brace in place.

Given there's no room for a radiator – or, indeed, any fans – in the top of the case, you'd be forgiven for thinking that this would limit the cooling options available to the View 37, but not so. There's a large space to the right of the motherboard that can take anything up to a 420mm triple-fan radiator (that's three 140mm fans), which mimics the options for the front of the chassis. There are mounting holes for a single fan at the back of the case, along with space at the bottom in front of the PSU as well. In the box, you get a pair of Thermaltake Riing 14 LED Blue fans to keep your system cool.

Speaking of fans, you're spoiled for choice when it comes to keeping the View 37 cool. For instance, you can mount up to three 140mm fans behind the front panel, or elect to go with more standard 120mm fans instead. Thermaltake has also been keen to show off this case with a pair of 200mm RGB fans behind the front panel, which you can clearly see through that front perspex piece to great effect. If you're looking for a fully pimped-out RGB system, there's certainly a lot to like here.

The case ships with a bracket to vertically mount your graphics card, although you'll need a PCIe extender cable, which is sold separately, to actually mount your graphics card this way. If you're not using this bracket, it's easy to remove. Given the theme of this case is showing off your machine's innards, it's a shame the cable isn't included with the case.

We found building inside the case a particularly pleasant experience, as it has improved access compared to most other chassis. There are plenty of options for drive mounting: there are four drive mounting brackets in the rear chamber that can hold four 3.5-inch drives or eight 2.5-inch drives; and the removable drive cage in front of the PSU can hold three 3.5-inch drives as well, giving you plenty of scope for hefty storage builds. There are plenty of routing holes for your cabling, too, and even though there's no PSU shroud, we didn't have a problem keeping things tidy, due to the healthy amount of clearance in the rear section of the case.

The View 37 is worth considering for anyone who values the aesthetics of a build. It lends itself more to a custom water-cooling loop than anything else, and benefits from a swath of LED lighting, but it can produce a stunning-looking machine. It isn't perfect, the materials aren't brilliant, and it's a big ol' case, but it has buckets of potential.

Alan Dexter

Verdict

Features	★★★★
Performance	★★★★
Value	★★★½

Striking looks and potential; brilliant storage options; great water-cooling options and spacious.

★★★★½

apc RECOMMENDS

PC CASE

$159 | WWW.CORSAIR.COM

Corsair Spec-06 RGB

An ideal home for flashy builds — if your retinas can take it.

RGB lighting has conquered its final frontier. After invading the territory below your keyboard, the sides of your headset, and the radiators, this unstoppable scourge — er, trend — finally makes it to the front panel of your case.

We're quite fond of the colorful flourish on the front, a swooping line of illumination, as though the case has suffered a war wound and is now bleeding pure Las Vegas Strip. And it's totally programmable and customisable, via a smartly affixed lighting controller at the rear. Three buttons control the speed, color, and mode, of which there are seven.

While the RGB functionality is well implemented — and it should be noted that there's a non-RGB model available, too, if illumination's not your thing — we're much more impressed by the fundamental space and layout within the case than what's going on outside it. Although its dimensions remain reasonable enough to fit under any desk , there's an abundance of space for builders within the case once you pop off the tempered glass panel. (And it's a small point, but we're delighted to see that the rubber stays around each hole are glued in place here.)

A compartmentalised PSU enclosure keeps the interior looking smart, and the cable feed-through cutout on the top panel of that enclosure is an especially nice touch. Keeping GPU power cables tidied away out of view just got that tiny bit easier. Meanwhile, cavernous clearances for CPU coolers and GPUs make building fairly effortless. In fact, we're fairly sure we've stayed in smaller hotel rooms than this, but this isn't a review of our poor life choices. Thank goodness.

So generous is the GPU clearance in both directions that the Carbide Spec 06 also has a couple of vertical mounting brackets for builders who really want to put their prized componentry centre stage. Doing so does mean creating quite a narrow space between the GPU fans and glass panel, but as the DIY system builders are no doubt already screaming, this doesn't seem to affect airflow or GPU core temps significantly. Not all the gear is provided if you want to orient your GPU vertically, though — you'll need to shell out for a riser cable separately, and it looks like a bit of case modding is required to actually affix it to the PSU enclosure.

If you're really worried about cooling, you could always make use of that space to fit a 360mm radiator at the front, a 240mm on the roof, and a 120mm at the rear. We've tested several other cases with similar theoretical capability for radiators this size, but few look so easy to install them in. In terms of air coolers, there's room for a total of six 120mm fans, and two are supplied. We'd say that's one additional front panel fan away from great value.

It won't come as a tremendous surprise to hear that there's room for four SSDs and two HDDs inside the Spec 06, positioned at the rear side of the motherboard mount, and again, easy to keep tidied away, along with their accompanying cables. It's a case just begging for clean lines and gaudy lights, and it makes it easy to achieve it. Yes, from certain angles the front panel protrudes too far, in order to give the fans breathing room. And yes, the finish could be better — our reset button was stuck in a depressed position, for example. But if you can live with those minor imperfections, you're rewarded with a showstopper aesthetic in wide focus.

Phil Iwaniuk

Verdict

Features	★★★★½
Performance	★★★½
Value	★★★½

A spacious case with well-executed RGB, but some design concessions and quality issues do slightly dampen the appeal.

★★★★☆

software

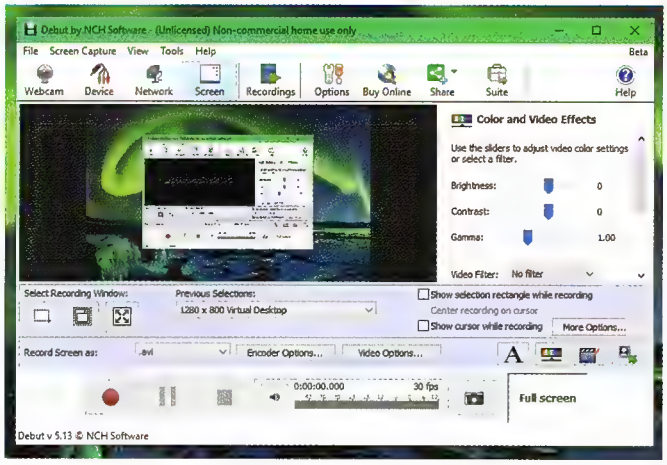
» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Debut Video Capture

An amazingly capable free screen recorder, and much more.

FREE | WWW.NCHSOFTWARE.COM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File Screen Capture View Tools Help
Beta
Webcam Device Network Screen Recordings Options Buy Online Share Suite Help
Color and Video Effects
Use the sliders to adjust video color settings or select a filter.
Brightness: 0
Contrast: 0
Gamma: 1.00
Video Filter: No filter
Select Recording Window:
Previous Selections:
1280 x 800 Virtual Desktop
Show selection rectangle while recording
Center recording on cursor
Show cursor while recording
More Options...
Record Screen as: .avi
Encoder Options...
Video Options...
0:00:00.000
30 fps
Full screen
Debut v 5.13 © NCH Software

There are dozens of free screen recorders for Windows available to download, but most are blighted by time restrictions, watermarks, bundled junk software and limited export options. Debut Video Capture from NCH Software, however, is an exception to the norm.

Debut is free for home use and has everything you need to capture footage from your screen, a webcam, or other connected devices like security cameras – including a wealth of features you'd normally only expect to find in premium software.

It isn't designed for recording games (that requires something like OBS Screen Recorder, which can handle full-screen, hardware-accelerated programs with ease – see **obsproject.com**), but for everything else it's ideal.

When it comes to recording your screen, Debut offers all the usual options, letting you capture your entire display, a selected window, or a custom region. You can choose to show or hide the cursor, and even highlight it when you click, which is extremely useful if you're recording a software demo or tutorial.

Once you're ready, either tap the red button or minimise Debut and hit one of its keyboard shortcuts (F5 or Ctrl-F9) to start recording. This is a really thoughtful touch, giving you a choice of shortcuts to avoid conflicts with other programs that use the same key bindings.

You can record from your PC's sound card, an external microphone, or both, and there's even picture-in-picture support so you can overlay a recording from your webcam on top of footage from your desktop.

Debut doesn't include a tool for editing your videos after they're saved, but you can adjust colours, apply filters, and add captions and watermarks while they're being recorded. Just take your pick from the buttons on the lower right, and check the preview pane to see the effect before you start recording.

Debut's interface isn't the most attractive, but what it lacks in gloss it makes up for in clarity. Everything is clearly labelled, and you'll never be left casting around for the option you need. It's also worth noting that the software is currently in beta, so the final release will hopefully look a little more polished. **Cat Ellis**

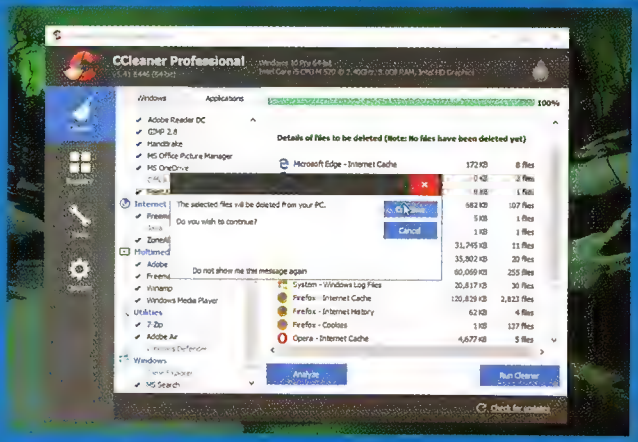
Piriform CCleaner Professional

Set-and-forget PC maintenance

$29.95 PER YEAR | WWW.CCLEANER.COM

Piriform CCleaner Professional is the premium version of the enormously popular free PC optimisation suite. As with that free counterpart, the basic scan in CCleaner Professional checks for cookies, cached files, downloaded files and history in all the major browsers, including Edge, Firefox, Chrome, Internet Explorer and Opera.

CCleaner also includes a comprehensive registry cleaner – a handy tool if you're experiencing registry-specific problems such as a new version of a program refusing to install, despite the older one being uninstalled. The Professional edition of CCleaner also includes a software uninstaller, a startup app manager, a duplicate file scanner, a drive wiper, a scan scheduler and automatic updates for all these components. The software uninstaller doesn't let you remove multiple programs at once, but it does display many more applications than Windows' built-in program manager – including pre-installed Windows

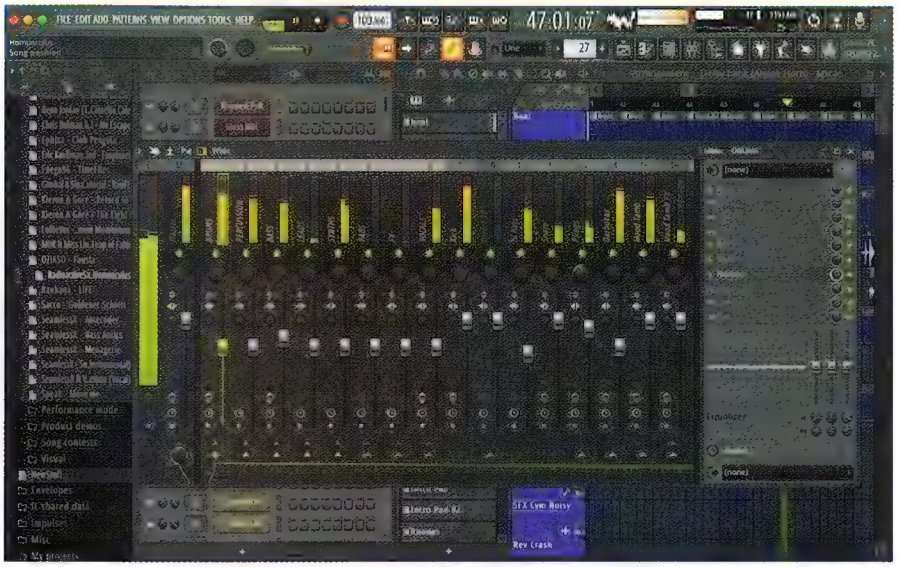


10 apps, which can otherwise be difficult to purge. All in all, CCleaner Professional is one of the best premium PC maintenance tools available today. **Cat Ellis**

FL Studio 20

The legendary looper makes it to the Mac.

FROM US$99 | IMAGE-LINE.COM



This app, formerly known as Fruity Loops, has been on PCs for 20 years. That explains the version number: technically, it's version 13, but this is the first time it's been made available as a full product for the Mac.

Previous attempts used the CrossOver compatibility layer, but FL Studio 20 is a native 64-bit app. It's fast, looks great on a Retina display, and isn't too taxing on your system. However, there are incompatibilities with VST plugins. If you're planning to duplicate your PC environment on a Mac, that's something you'll need to check; if this is a concern, it's worth checking out the compatibility list, which you'll find at **bit.ly/flwinvsmac**.

The main difference between FL Studio and apps such as Apple's own Logic is philosophy. FL Studio began as an app for quickly making loop-based music, and while it's gained lots of powerful features over the years, it's still based on that philosophy: the basic edition still assumes you won't be recording vocals or live instruments.

Logic is much more focused on recording and production and, while it does of course work happily with loops, it's harder to learn and more cumbersome than FL Studio. Where Logic can have newcomers utterly baffled, FL Studio will have you making beats within minutes. It's telling to compare FL Studio's celebrity users: FL Studio is dominated by musicians, whereas with Logic producers and composers dominate.

That doesn't mean FL Studio isn't for production – far from it. It offers up to 500 tracks of multi-track recording and arrangement, time-stretching and pitch-shifting, one of the best piano roll editors around, and a mixer that can be as simple or as complex as you want it to be. There's also a companion app for iOS – FL Studio Mobile ($21.99) – that you can use to create productions on the move.

FL Studio is an excellent audio app, but it's late to the Mac: chances are, when you see a Mac musician making loop-based music, they'll have already embraced Ableton Live. But if you haven't already chosen your preferred music app, you should seriously consider FL Studio. **Carrie Marshall**

Drafts 5

A powerful, versatile text editor

FREE WITH IAP | GETDRAFTS.COM

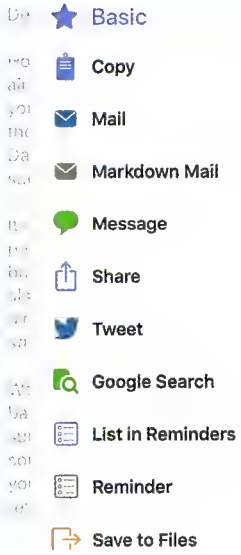
While not designed for long-form writing, Drafts 5 is capable of that. It's also good for to-do lists, quick thoughts, or jotting down ideas.

Drafts is now free, and has an updated editor, tagging, Siri integration, tappable task check marks and improvements to the arrange mode, which lets you reorganise blocks of text using drag and drop. A Pro subscription (US$1.99 monthly or US$19.99 annually) unlocks advanced features like themes, custom icons, editing actions and more.

Our favourite new feature has to be tags; rather than organise content by folders, Drafts 5 lets you add custom tags to notes, making it a snap to find something. (You can also do this in bulk by selecting multiple notes.)

Drafts 5 integrates well with SiriKit; in other apps Siri stops listening after about 45 seconds, but the developer has circumvented this, so you can dictate for minutes at a time.

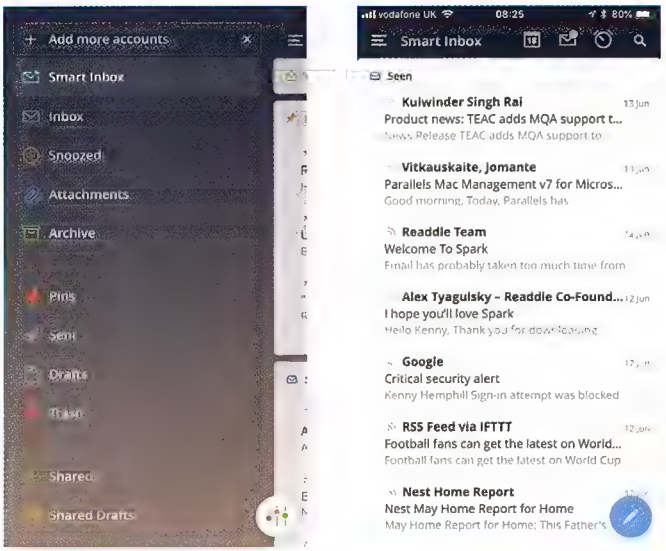
Considering all the potential input methods, it's surprising to find there's no direct import, particularly from Apple Notes, but this is a small quibble, since notes can easily be shared without styling. **JR Bookwalter.** ■



Spark

A smart, sophisticated email client.

FREE | SPARKMAILAPP.COM



There is no shortage of email clients vying for space on your iPhone or iPad's home screen, so why should you be bothered about another?

Well, for one thing Spark is more than just an email client. Sure, it allows you to send and receive email from any account, and to file it, flag it, or even ignore it if that's what you want. But Spark also merges features from collaborative tools such as Slack and Microsoft Teams. Its premise is that email is still at the centre of most of our working lives, so why not build a tool around that, rather than use something different?

The result is an email client, available on the desktop, as well as mobile, that allows you to share drafts with colleagues and chat to them right inside the app. Alternatively, you can work together to write the draft. Email messages can be shared as URLs and viewed by anyone with the link.

Also new in Spark 2.0 for iOS is integration with a host of third-party apps and services, like Reminders, Things, Evernote, OneDrive, Google Drive, iCloud Drive and Dropbox. That integration makes it very easy to turn email messages into notes or to-do list items.

Spark doesn't skip on the features you'd expect from a modern email client, either. Messages are siloed by default into what Spark calls 'buckets', promoting the most important messages and keeping, for example, newsletters out of the way in their own bucket. By default, pinned messages are displayed at the top of the screen, with the most recent three pinned messages shown. However, if you're like us and are somewhat haphazard in the way you use pinned messages, you can very easily change this behaviour so that they're not given prominence.

Messages can be snoozed, so that they pop up again later, and the quick reply feature allows you to respond with an emoji. Built-in widgets allow you to see a list of emails you recently opened, reminders, and a calendar – if you use a Gmail account, for example, it pulls in your Google calendar.

Spark is very customisable, something that's important in a tool that wants to be at the centre of your working life. You can change the options for the length of time messages snooze, change what swiping gestures do, and change how widgets are displayed.

It's also very smart – the first time we composed a draft, it displayed email signatures we'd used previously in other clients and asked which one we wanted to apply. We also liked the option to add a reminder to a draft that didn't receive a reply within a set period.

Search – a crucial email feature for most of us – is pretty good, too. It fooled us at first, however, only suggesting names and email addresses in results. It was only when we pressed Return on the keyboard that it delivered results with the search term in the subject line or body.

Spark is brilliant for teams who rely on email. However, even if you work alone, there are still several features that make it worth downloading. **Kenny Hemphill**

WikiCompass

A personal tour guide in your pocket.

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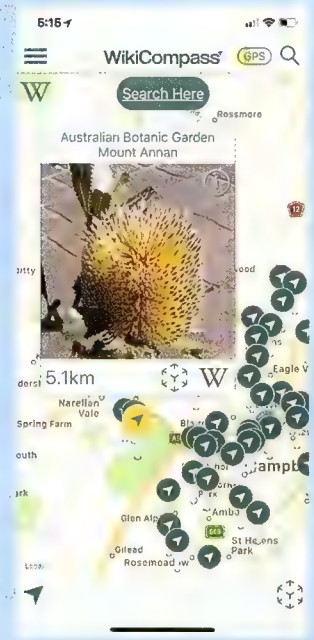
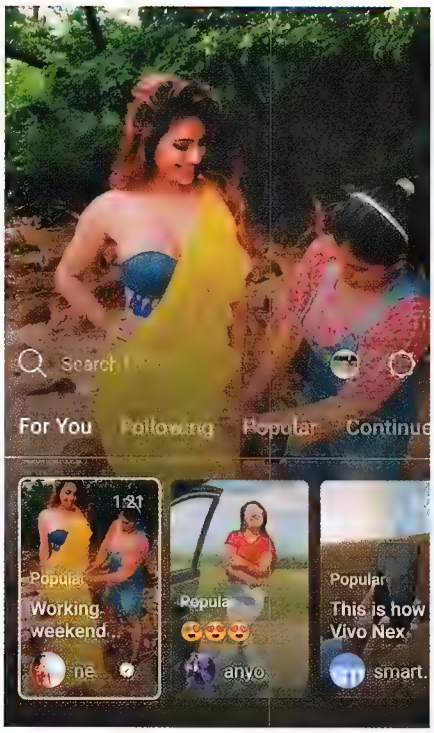


While there are travel apps aplenty, there aren't many that provide information about a location when you're at the spot, unless you've got a local guide or have done your research beforehand. If you haven't managed either, WikiCompass will do the needful. The app puts the power of Wikipedia's vast library into a map so you can learn more about where you are in real time.

The app uses a GPS signal to find hotspots around you, then pulls up Wikipedia articles — if any are available — relating to each location, letting you view them in augmented reality. You will, however, need an internet connection to use the app as it won't work offline. To get the info you want, just launch the app (which will set you back $1.45), then tap on any location marker from the multitude of hotspots the app picks up. Your selection will reveal an image of the place, its name and distance from you, along with two icons: the 'W' will launch the related Wikipedia page, while the hexagon takes you into the app's augmented reality view. There isn't much in the way of settings, though, other than clearing search histories and lowering search distance. The search distance starts at the maximum of 10km but can be shrunk to half a kilometre if you're looking for something specific. **Sharmishta Sarkar** ■



IGTV

Instagram gets a video-only vertical playing app.

FREE | WWW.INSTAGRAM.COM

Since Instagram added video-functionality to its core application in 2016, what the app lost in simplicity it gained in popularity. For many, presumably younger people, on-the-go video content with portrait orientation in mind is a daily staple in their media diet consumed on a phone screen.

IGTV is effectively a free video streaming service, but the video is, well, Instagram stuff. During the first five minutes spent using IGTV, we saw a pretty even split between scantily clad women addressing the camera and... zany injury montages. In some ways IGTV neatly encapsulates how media in general is changing. Rarely does a video on IGTV last longer than a minute, and the app is geared towards delivering an endless stream of material which can feasibly be viewed with the sound down in busy public spaces. The app will try to deliver material based on what you've already viewed, and it's possible to follow other IGTV users that cater to your interests. But it's unclear whether the app will see much uptake beyond your typical youth-oriented YouTube personality fodder.

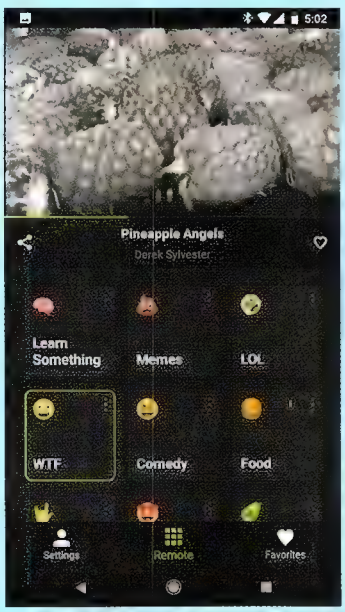
Of course, it's possible to create your own channel and upload your own videos. But with a UI that seems geared more towards showing featured content, rather than promoting discoverability, it might be a while before we know how much impact IGTV can have. **Shaun Prescott**

Neverthink

Sit back and zone out.

FREE WITH IAP | NEVERTHINK.TV

The name may be a tad Orwellian, and while some of those connotations survive in the app's functionality, the end-product is more harmless than that. Neverthink's aim is one of convenience — to be "the TV of the internet" — and the title references the fact that the videos on the app are curated for you, removing the need to think about what to watch. You just have to choose from one of the app's categories — world news, memes, documentaries or LOL — and your stream of videos is ready. Neverthink streams videos from YouTube, so you'll be familiar with the interface. This service is proudly algorithm-free, however. Instead, the team at Neverthink hand-pick videos every day, selecting what they deem appropriate for each channel. If you're in the habit of getting caught in YouTube-holes, then this app will certainly exacerbate it (for better or for worse). **Harry Domanski**

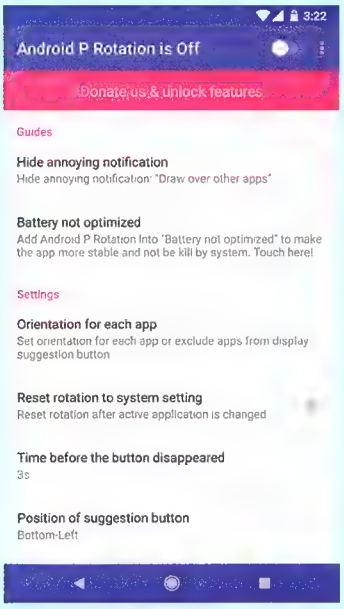


Android P Rotation

A clever solution to an everyday problem.

FREE WITH IAP | WWW.FACEBOOK.COM/PG/THTEAMSOFT/

As is often the case with upcoming Android features, an app dedicated to a specific function will no doubt find its way to the Google Play Store ahead of the next major version release. This is great for users who wouldn't have gotten the feature anytime soon, but there's a good chance that the app designer won't quite do as a good job as Google. As this app's name implies, the feature it's mimicking is a rotation trick found in Android Pie. Instead of a phone that's locked to either portrait or landscape, or one that automatically changes its display orientation with the handset, this function offers a happy medium. Flip the phone and a small icon will briefly display — tap to change the orientation or ignore it and it goes away. The feature is genius for avoiding accidental shifts, but this app is flaky and intermittently disables the function. **Harry Domanski**


3:22
Android P Rotation is Off
Donate us & unlock features
Guides
Hide annoying notification
Hide annoying notification "Draw over other apps"
Battery not optimized
Add Android P Rotation into "Battery not optimized" to make the app more stable and not be kill by system. Touch here!
Settings
Orientation for each app
Set orientation for each app or exclude apps from display suggestion button
Reset rotation to system setting
Reset rotation after active application is changed
Time before the button disappeared
3s
Position of suggestion button
Bottom-Left

Stacer 1.0.9

A graphical system monitor and resources optimiser.

FREE | BIT.LY/LUD_STACER

System monitoring is an essential task for any user. Although you'll find several system monitors in distribution repositories, Stacer offers the added benefit of an attractive user interface that's intuitive to navigate. Besides monitoring, you can also use it to optimise and fine-tune several aspects of your installation – like Bleachbit, but with a nicer interface.

Stacer has a PPA repository for Ubuntu and also hosts precompiled RPM and DEB files in addition to an AppImage for other distributions. The app's dashboard displays information about the system and has dials to depict the activity levels of the processor, memory and disk, along with bars for download and upload speeds. You can also configure the app to alert you in case the readings on any of the dials exceeds a defined level. Use the icons on the left to switch to the different components (or areas) of the app. You can add and disable startup apps and control other installed services. The app also helps you free up disk space by removing unwanted files from particular locations, such as the Trash and package caches. In the same vein, it can also display a list of all installed apps and enables you to uninstall any of them.

KShare

Neat clone of a top Windows screen-sharing utility.

FREE | GITHUB.COM/ARSENARSEN/KSHARE

Sometimes we come across a great open source app that we'd love to see on Linux, but it can't be compiled properly because it's been developed for Windows or macOS. One of the most telling examples is ShareX, a gorgeous screenshot-taking utility that's a Windows-only program. Fortunately, the author of KShare has stepped in with this decidedly similar creation, which feels a lot like a clone of ShareX.

KShare is much more than just a screen grabber. It's a productivity tool that can upload images to Imgur or the clipboard, and also record video screen casts. We spent a minute or two compiling KShare using Qmake and found out that KShare beats many other screen grabbers, if not all.

Once you launch KShare, select Screenshot> Fullscreen and in a second or two you'll have the Imgur link to your image in your clipboard. It's great for sharing your grabs on a forum or elsewhere online. The Screenshot menu also has options for grabbing a custom area or an active window only, and if you go with a custom area then a live magnifier attaches to your mouse cursor, so that you can capture areas of your screen with pixel perfection.

KShare has a large, hard-to-miss Settings button in the centre of its window. Here you can change the destination, file scheme and local path for saving images, but the most useful is perhaps Hotkeys. KShare enables you to associate its six main features to your own key bindings and work even faster. Apart from taking still shots and recording videos from custom screen areas (powered by FFmpeg), KShare can also work as a colour picker and instantly save HTML code of a picked colour directly to your clipboard. Try KShare and see how it boosts your productivity! **Alexander Tolstoy**

Qt314wall

Automatic wallpaper changing for KDE.

FREE | GITHUB.COM/CMDRKOTORI/QT314WALL

This program's name reads like an obtuse answer to a brain-teaser, but Qt314 is a wallpaper changer that's specific to KDE (both generations 4 and 5). Despite the fact that the KDE Plasma desktop is supposed to be extremely configurable, some features are still missing. Qt314wall fills the gap of automatic wallpaper changing, which is a feature that's not immediately available in KDE. There are some technical obstacles in implementing this in KDE Plasma natively. For example, if you decide to add a context service menu to Dolphin for setting an image as a wallpaper, you'll find that it will only work when the desktop widgets (aka plasmoids) are unlocked. Qt314wall works in its own manner and sets an image as a current background via the <code> xsetbg </code> command in case of the older KDE 4, or triggers the change event by calling Plasma 5 using Dbus.

The main interface contains a fair few options and invites you to start with the source of your images. You can feed a directory with your own pictures, provide a list of files, or select a web image board from the list. The change event occurs smoothly thanks to the compose effect, and it looks beautiful and natural. Qt314wall is able to scale images to the size of your screen, crop it and retain the aspect ratio — all these controls are at your fingertips. Interestingly, the program doesn't produce any temporary files on your hard drive because it stores its runtime files in /dev/shm. This is an exceedingly smart design decision!

If you decide to use low-res images as wallpapers, Qt314wall upscales them very smoothly, so that they don't look blurred or pixelated. The secret is in the Waifu upscaling algorithm, which works perfectly on any kind of bitmap images. Give Qt3124wall a try; it's fun, useful and integrates some state-of-the-art tech! **Alexander Tolstoy**

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PAGE 48
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Confused about which products actually protect your privacy? Nathan Taylor has rolled up his sleeves and is ready to talk tools.

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INCREASE YOUR FACEBOOK SECURITY
Ian Evenden tells you how to keep your social life safe online.

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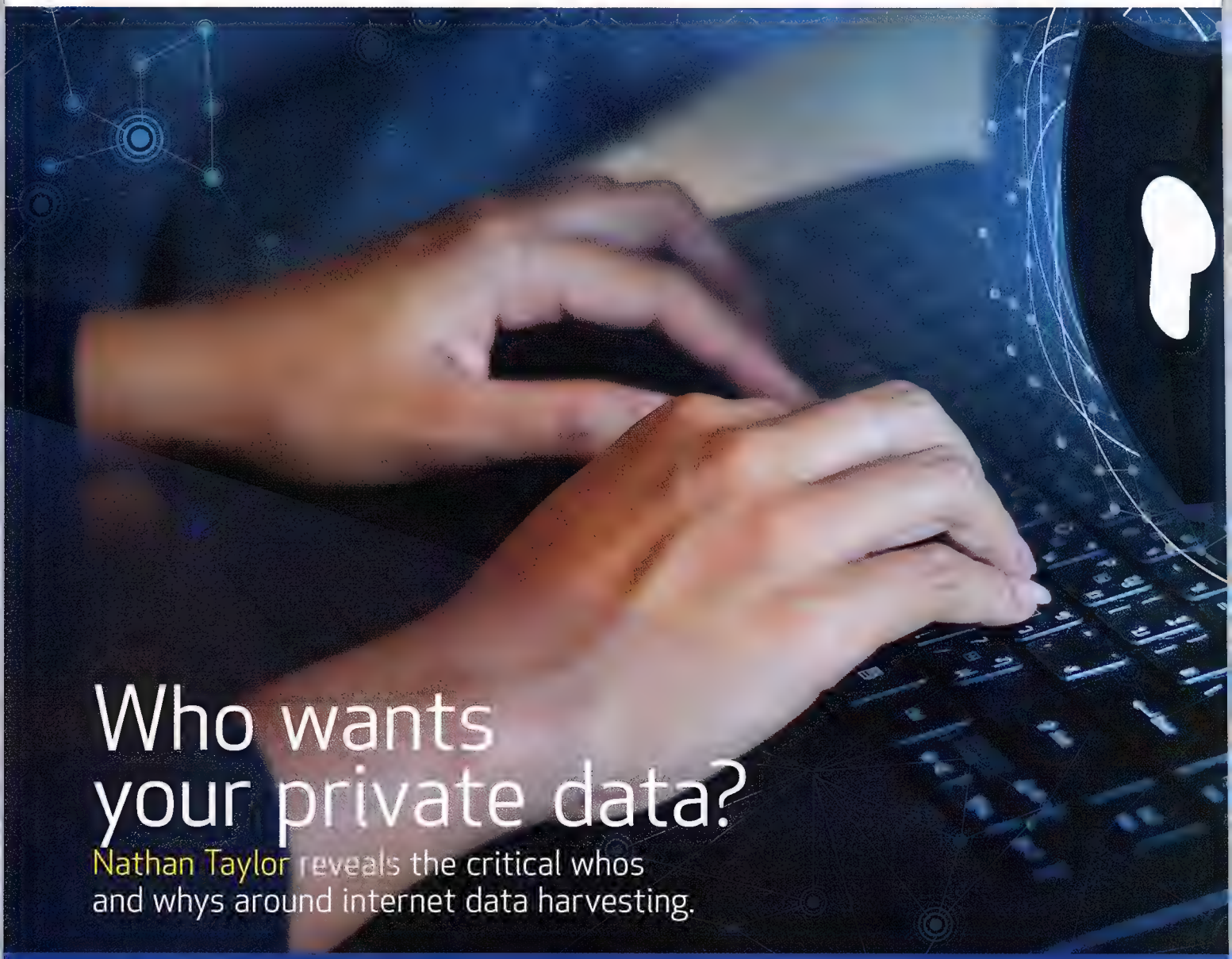
GIVE YOURSELF A GOOGLE PRIVACY CHECK
Nathan Taylor's guide on how to stop the search engine from tracking your online activity.

PAGE 60
HOW TO STAY PRIVATE IN WINDOWS 10
Microsoft gathers your data — here's how to cut the cords.



Who wants your private data?

Nathan Taylor reveals the critical whos and whys around internet data harvesting.

Have you ever bothered to go into the Google, Microsoft or Facebook account settings to download your profile, which should (in theory) contain everything the company has on you? Most people will be quite shocked if they do – the amount of data the companies collect on their users is staggering. With Google, for example, every search you've ever performed, every result you've clicked on, every time you've logged in (and from where), every YouTube video you've watched, every relationship and contact you have, the complete movements of your mobile devices and more is collected and stored forever in Google's database, unless you explicity ask it to delete the information.

And that's just what internet services are tracking. Lots of others organisations are looking to track your online activity and communications as well: governments, ad networks, criminals, businesses and more. So let's break it down and look at some of the organisations that are tracking you online and why they do it.

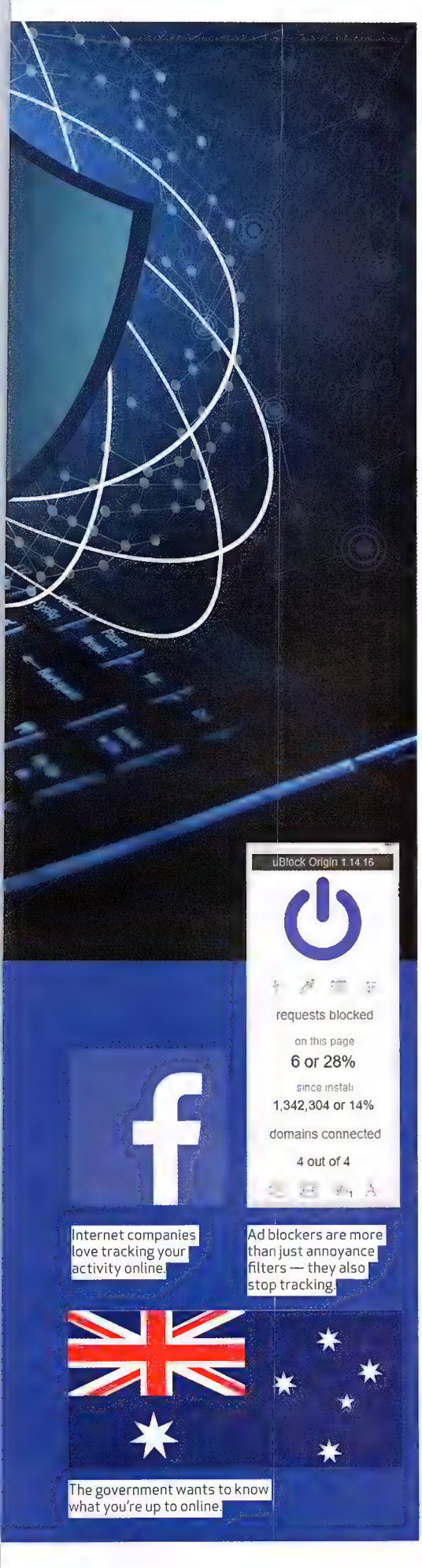
GOVERNMENTS

Governments obviously have a keen interest in monitoring the communications of citizens, both foreign and domestic. Many of the world's most devastating recent malware outbreaks came from government-sponsored skunkworks, particularly from Russia, China and North Korea, which have highly active cyberwarfare units.

The motivations of governments vary. In more authoritarian regimes it may be political, but even in democratic countries there are considerable demands from law enforcement and intelligence agencies for more power and capability to monitor communications.

As software to prevent spying has gotten better, governments around the world have started pushing back harder and harder. For many years it was mostly broad monitoring of internet communications that served the governments, with massive data centres that monitored web traffic as it traversed the internet's backbones. As end-to-end encryption has become more prevalent, governments have turned to new methods – malware development, and legislatively enforced cooperation from communications providers and software developers.

The Australian government is no exception. In 2015 it passed data retention laws that came into effect last year, requiring that all communications network providers (such as your internet service provider, or ISP) keep metadata logs for at least two years. That is, your ISP logs every site you visit and when, and it must


uBlock Origin 1.14.16
requests blocked
on this page
6 or 28%
since install
1,342,304 or 14%
domains connected
4 out of 4
Internet companies love tracking your activity online.
Ad blockers are more than just annoyance filters — they also stop tracking.
The government wants to know what you're up to online.

hand over that information on request. Recently it also introduced the draft Assistance and Access Bill, which requires all tech companies to (secretly) assist the government and crack into their customers' communications on request.

CRIMINALS

Criminals have obvious reasons for wanting to grab your personal data – they want to make money from you. Personal data can be used for fraud and identity theft, allowing them to make purchases from your credit card for example, or sign up for new credit cards in your name. It can allow them to break into your other services and monitor your email and send spam, or to harvest the information of friends and family as well.

Personal information can also be used in spear phishing attacks, where scams and attacks get targeted specifically at you, making them seem plausible. If they learn that you use a particular bank, for example, that can make a bank phishing attack more successful.

AD NETWORKS

Most of the world's internet advertising is actually dominated by a small handful of companies. This gives them tremendous power to monitor and track a person's internet usage. From those usage patterns they develop a user profile to deliver advertising, since targeted ads command a premium. If you visit a lot of surfing-related sites, for example, you'll start seeing a lot of ads for surfboards appear, even when you're not on a surfing-related website.

Here's how it works:

1 A web page owner would like to make some money off that page, so they go to an ad network. Ad networks pay site owners for a "slot" on their page, with rates often determined by clicks or visits.

2 The ad network will provide the website owner with a bit of code that they can embed on the page. When someone visits the webpage, that code grabs an ad from the ad network, which gets loaded into the page.

3 Often a cookie gets uploaded to the visitor's browser to indicate they visited the site. So if you're browsing a surfing site, an you see will upload a cookie (called a tracking cookie) to your browser.

4 Then you visit another site, and it also has an ad in it from the same ad network as the first site. The ad code from this new site can grab the cookie that was uploaded earlier and is updated to this second site. Now the ad network knows that you're the same person that visited the surf site.

5 As you visit more sites, the cookie gets updated again, letting the ad network know every site you visit. From that, it can create a complete picture of your interests and likes to deliver targeted ads.

OTHER INTERNET BUSINESSES

Internet businesses as a whole love to gather information on their users. Any information they can get, they want – demographics, personal information, relationships, software, site activity, websites visited. Just visiting a regular website – not filling out forms or giving up personal information – gives a site your IP address, which in turn provides your general location and ISP. They know your browser and operating system. A site can upload cookies, which keeps a historical log of your visits to that site.

When you start filling out forms, things can get really intrusive. Sites often ask for unnecessary information just so they can get a better bead on your personality and wants.

There are varying degrees of intrusiveness. For example, Google by default will hoover up vast amounts of information, but gives you fairly accessible tools for opting out of its data gathering. Google's revenue primarily comes from ads attached to search results – as such it's doesn't need to gather personal information to make money off you. If you use Google Search, they're already making money off you.

Then you have companies like Facebook whose entire business model is built on analysing your personal information to deliver targeted advertising. The opt-out features for these services tend to be more arcane and less accessible, designed to make it as hard as possible. Like ad networks, many of these services can also track you across multiple sites, thanks to widgets embedded in web pages (such as Facebook Like buttons) that can monitor what sites you visit and relay that information back to the company.

Of late, the European General Data Protection Regulation (GDPR) has curbed some of the worst excesses of companies, but most still gather as much as they can get away with and make it hard to be forgotten.

As with all tracking, the key is to know what kind of information you're giving away, to understand how you can avoid giving it away, and taking measures to insulate yourself against overly nosy internet denizens. ■

Essential digital privacy skills

Up your personal security game with Nathan Taylor's guide to the 10 key digital privacy skills you need to know in 2018.

Maintaining your privacy and security online is not really that hard, but it's a task far too many people fail it. So here are our top ten tips to get you started.

1 USE A VPN ON YOUR PHONE AND PC

When it comes to personal privacy, VPNs are good for what ails ya. They have the effect of both protecting your identity from the sites that you visit and preventing anyone in between from reading the contents of your data or knowing who you're communicating with. It stops snooping from governments, ISPs, network providers and websites. The only party that knows what you're doing online when you're connected to a VPN is the VPN provider, and most of those deliberately don't keep logs.

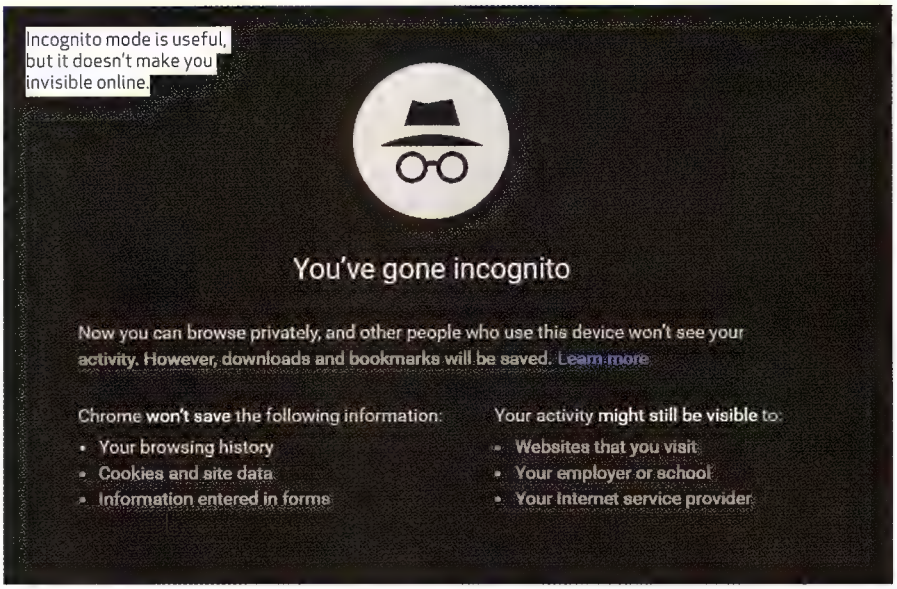
It's not just for your PC either. Your mobile phone can use a VPN as well. It's especially relevant when you connect your device to public Wi-Fi networks. When you share a Wi-Fi network with strangers (in a hotel or cafe, for example), it's easy for someone else connected to the same network to intercept your traffic. A VPN prevents them from reading your data as it is sent over the airwaves.

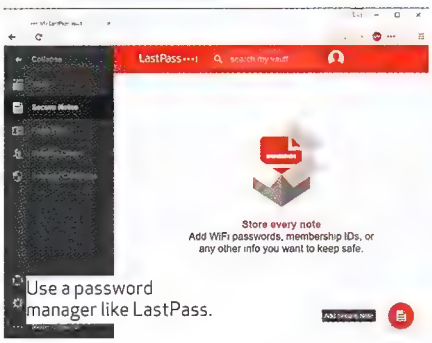
2 KNOW WHAT YOUR BROWSER'S PRIVACY MODE DOES AND DOES NOT DO

Private modes (incognito mode in Chrome) were a great addition to browsers, but you should be aware of what they can and cannot do.

What they will do is delete any cookies and other data you download during the private browsing session. No history will be recorded, and your autofill forms won't be updated. Certain plugins will be disabled. Essentially there will be no trace on your local computer that you visited the site.

What they don't do is stop people from listening in on your communications or prevent the website you're visiting from knowing your IP address or browser details. It doesn't make you anonymous online – for that you need the services of a VPN, a proxy or Tor.


Incognito mode is useful, but it doesn't make you invisible online.
You've gone incognito
Now you can browse privately, and other people who use this device won't see your activity. However, downloads and bookmarks will be saved. Learn more
Chrome won't save the following information:
Your browsing history
Cookies and site data
Information entered in forms
Your activity might still be visible to:
Websites that you visit
Your employer or school
Your Internet service provider


LastPass
Store every note
Add WiFi passwords, membership IDs, or any other info you want to keep safe.
Use a password manager like LastPass.

3 USE DISPOSABLE EMAIL ACCOUNTS

Every site on the internet now wants to know your email address – demands to know it if you want access – and there are plenty of those that you never, ever want to give your real email address to.

That's why it's always a good idea to have a few 'burner' email addresses up your sleeve. Go to a free web email provider and create a few accounts that you never intend to use for actual communications. Then, when you come across a site that wants your email address, you can give it one of these, sparing your real email address the torture of being added to spam and malware distribution lists.

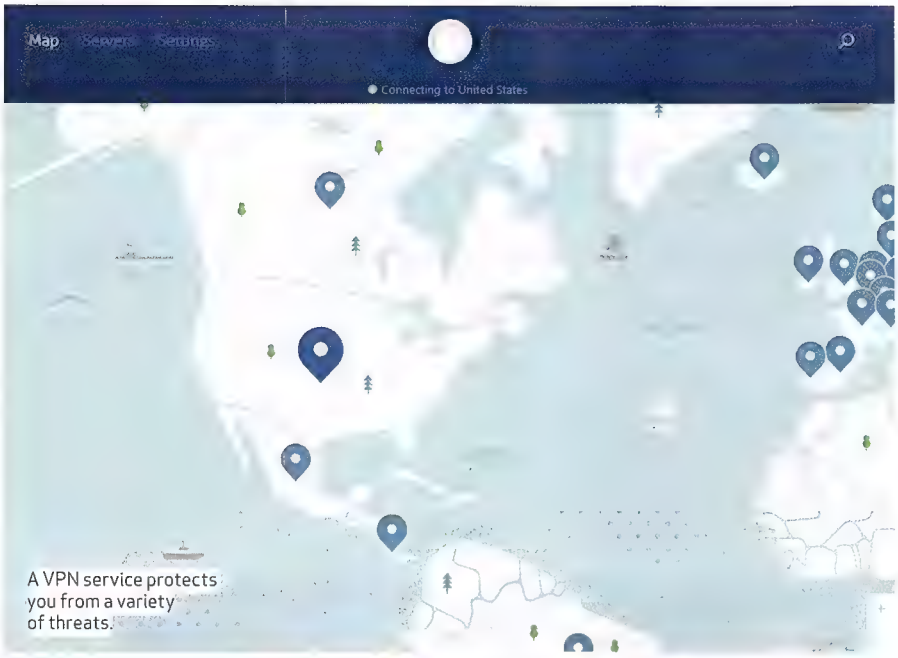
4 OPT OUT

As the saying goes, if something is free then it's not the product; you are. Whenever you're offered something that you didn't specifically ask for free, just say no. No to "special offers," "free security software," "free trials," or anything else that people try to foist on you. None of it is ever good.

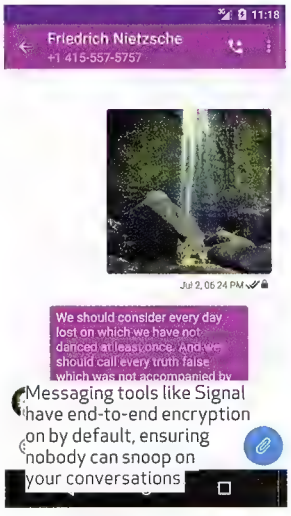
We actually have a number of programs we like that can help you out with rejecting crud. One of our favourite is Unchecky (**unchecky.com**), which automatically deselects "special offers" during program installs. Many suites and security tools also have PUP (potentially unwanted program) removers built in, to clear the junk off your system.

5 MANAGE YOUR PRIVACY SETTINGS

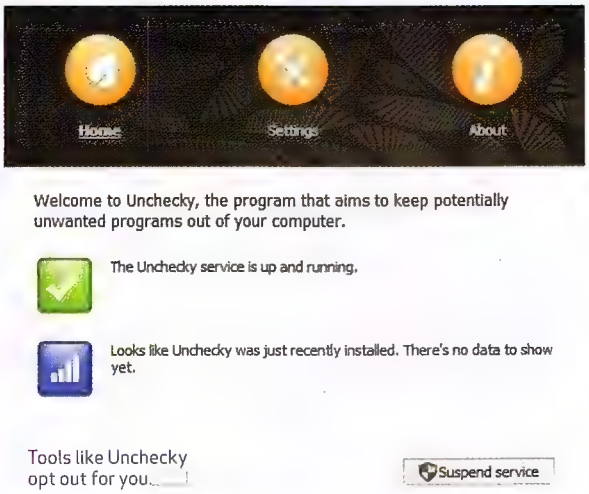
Following a long history of privacy scandals, most of the major social media and internet services companies now provide the option to skip out on large portions of their data gathering apparatus. They don't actually want you to turn up your privacy settings, so they often make the process as arcane as possible, but the fact is that you have



A VPN service protects you from a variety of threats.


11:18
Friedrich Nietzsche
+1 415-557-5757
Jul 2, 06:24 PM
We should consider every day lost on which we have not danced at least once. And we should call every truth false which was not accompanied by

Messaging tools like Signal have end-to-end encryption on by default, ensuring nobody can snoop on your conversations


Home
Settings
About
Welcome to Unchecky, the program that aims to keep potentially unwanted programs out of your computer.
The Unchecky service is up and running.
Looks like Unchecky was just recently installed. There's no data to show yet.
Suspend service

Tools like Unchecky opt out for you.

"For every social media account you have, take the time to check the privacy settings. As a rule of thumb, turn everything to "off.""

a lot of tools now to opt out of their record keeping systems.

For every social media account you have, take the time to check the privacy settings. As a rule of thumb, turn everything to 'off'. It will probably save you a lot of grief in the future.

6 DON'T GIVE UP YOUR LOCATION OR PRIVATE DETAILS

This one seems too obvious to even list here, yet too many people still fail this basic test of internet privacy. Don't give out any personal details to anyone unless you're 110% sure they're legit. Yes, that's 10% more than 100%. Don't let them to know your location; reject notifications; and don't give out your real email address, where you went to school or your mother's maiden name. Don't tell them your birthday or partners name. Nothing. Tell them nothing.

7 USE STRONG PASSWORDS (AND A PASSWORD MANAGER TO REMEMBER THEM)

Most passwords are very easy to crack. Criminals use what are called dictionary attacks to crack passwords – they simply try every word in the dictionary and some common phrases and tricks.

This is why you need good passwords – and adding a '1' to the end of a dictionary word or replacing a few letters with numbers (like "f00tb4ll") doesn't cut it. They're on to those tricks. You also need a unique password for each site – if they crack your Twitter account there's a 100% chance that they'll immediately try Google, Microsoft, Facebook and every other social media account with the same password.

Of course, nobody can remember good passwords, so it's essential you use a password manager like LastPass to keep track of them for you. It means you only have to remember one good password, and the manager can take care of the rest.

8 WATCH WHAT YOU DOWNLOAD, AND TEACH YOUR KIDS

Only download software from the developer's site or certain trusted online marketplaces like Google Play or iTunes. Never download executable software from BitTorrent or pirate sites. That's where malware is born.

This is an important lesson you need to teach your kids and family as well. Kids in particular are inclined to download whatever without thinking of the consequences, which is why the average kid's computer is a nest of viruses and unwanted programs. (One good way to fix this, by the way, is to use User accounts in Windows rather than Admin accounts for your kids. This prevents them from installing software without permission.)

9 KNOW YOUR SCAMS

Staying abreast of the state of the art in online scams is a pretty key skill for staying safe online. Scammers can be quite sophisticated, and the best defence against them is to know what to look for.

We can highly recommend the government's Scamwatch site (**www.scamwatch.gov.au**), which has up-to-date details on the latest tricks doing the rounds. Check in once a month or so just to see what's happening.

10 USE ENCRYPTED MESSAGING

If you don't want anybody listening in on your private communications, you need to use a communications tool that has end-to-end encryption. End-to-end encryption is not nearly as complicated as it used to be, and it's actually built right into a large number of popular messaging tools now. Even Skype has it as an option (though it's not on by default).

The most secure solutions are the ones built for security, however. Signal and Telegram are messaging tools that are deliberately and specifically built for security – not even the software makers can tell who you're talking to or what you're saying. ■

Apps & services for keeping your digital life private

Confused about which products actually protect your privacy? Nathan Taylor has rolled up his sleeves and is ready to talks tools.

There are a million apps around now that promise to keep your private life out of the hands of snooping governments, companies and individuals – so many, in fact, that it's difficult to know which ones actually offer useful protection, and which just aren't worth installing at all.

Below, we've put together an up-to-date list of the best services and apps that actually do their jobs when it comes to keeping you safer, and your information and communications more private.

Read on for the *APC* team's personal privacy picks.

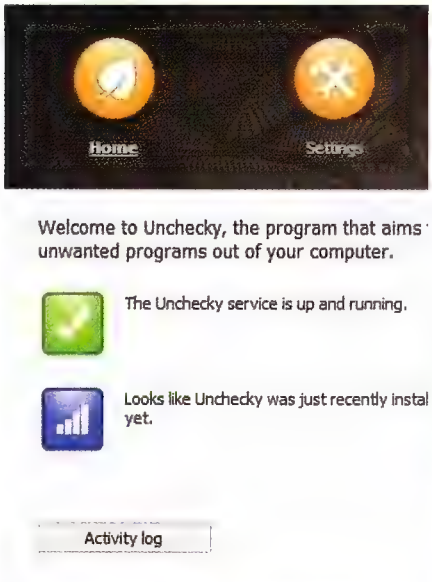
BEST APP FOR PRIVATE WEB BROWSING

Epic Privacy Browser

EPICBROWSER.COM

There are a variety of free secure browsers available now, but Epic Privacy Browser remains our favourite. It's the perfect browser to do your banking with and to use if you plan to go visiting some of the shadier corners of the internet. Heck, it's useful for general surfing, since it blocks corporate tracking as well. It does a lot of stuff behind the scenes: anonymises searches, prevents tracking and fingerprinting, removes ads, runs in permanent private mode, and even has a built in one-click proxy to hide your IP address.

Recommended alternative: Opera (**opera.com**), for those who want something less hardcore than a full-on privacy browser. It has a built-in free VPN, which is awesome, as well as an ad blocker and tracking script blocker.


Home
Settings
Welcome to Unchecky, the program that aims
unwanted programs out of your computer.
The Unchecky service is up and running.
Looks like Unchecky was just recently instal
yet.
Activity log

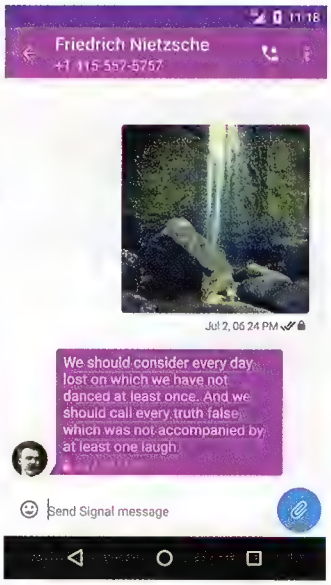
BEST TOOL FOR MAKING SURE YOU'VE OPTED OUT

Unchecky

UNCHECKY.COM

Unchecky is a really simple app that automatically rejects any "special offers" and other crapware that gets bundled with apps. It's light and simple, and you can just leave it running in the background. It's especially useful if you're the kind of person who likes to try out new software – or if you have someone in your house who is inclined to do a lot of downloading.

Recommended alternative: Ninite (**ninite.com**), which is a godsend if you're installing your favourite free apps on a new system. It allows you to check the apps you want, and it will download and keep them up to date for you, while opting out of any other associated apps.


Friedrich Nietzsche
+1 115-557-5757
Jul 2, 06:24 PM
We should consider every day lost on which we have not danced at least once. And we should call every truth false which was not accompanied by at least one laugh.
Send Signal message

BEST SERVICE FOR PRIVATE TEXT AND VOICE CHAT

Signal

SIGNAL.ORG

Signal, which was created by unifying the apps RedPhone and TextSecure, is often credited as the app that got this whole end-to-end encryption thing rolling, and the one most often recommended for private chat since it is open source and free. Many of its competitive apps use what has become known as "the Signal protocol" for private messaging.

Unlike a lot of open source projects, it's also extremely user friendly, with an interface every bit as accessible as something like WhatsApp. It uses your existing contacts list, and will automatically make encrypted connections if it detects the person on the other end has Signal.

Recommended alternative: Threema (**threema.ch**) has a similar level of security and ups the ante with completely anonymous user accounts.

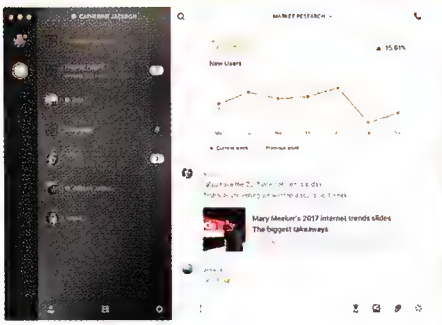
BEST SERVICE FOR PRIVATE EMAIL

PROTONMAIL.COM

ProtonMail is just about every privacy buff's go-to for secure email. ProtonMail messages between users of the service are protected by end-to-end encryption so that ProtonMail itself can't read them. It supports OpenPGP encryption for email to non-ProtonMail users, as well as a symmetric encryption system where you can send a link to an encrypted webpage that only a person with a specific passcode can read.

What's more, mailbox data on Protomail's servers is encrypted so that even the company can't access it. It keeps no IP logs, requires no personal information to create an account, can have mail set to self-destruct, uses open source code and is located in Switzerland, which has some of the world's best privacy laws.

Recommended alternative: MailFence (**mailfence.com**). There are quite a few good alternatives to ProtonMail (HushMail and Countermail, for example), but MailFence has a simplicity that we really like. It uses OpenPGP for end-to-end mail encryption, and while it stores keys on its servers, those keys are protected by a passcode only you have.



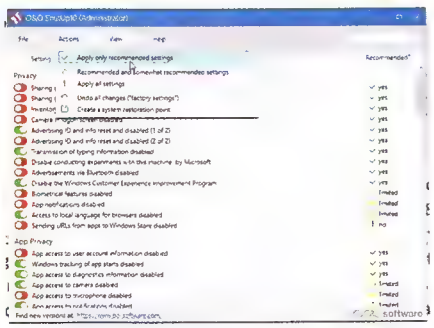
BEST SERVICE FOR PRIVATE VIDEO CHAT

Wire

WIRE.COM

Secure video conferencing is hard to pull off. Once you get more than two people on the call, the video streams have to go through a mixer to join them, meaning they can't be encrypted in transit. That's why many video chat apps with end-to-end encryption offer it only for one-to-one calls. Wire has solved that problem by designating one participant on the call as a mixer. For that participant, the bandwidth and CPU requirements will be high, so it limits encrypted video calls to four people. Still, that's three more than most solutions. Wire isn't free, but it is extremely capable and accessible, and will do voice and text chat, as well as screen sharing and syncing.

Recommended alternative: Riot (**riot.im**), a free and open source solution with encrypted one-to-one video, voice chat and private rooms.



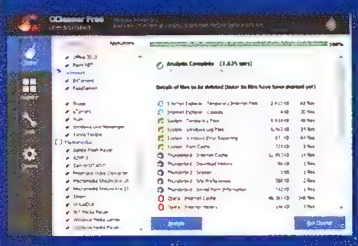
BEST TOOL FOR STOPPING WINDOWS SNOOPING SHENANIGANS

O&O ShutUp10

OO-SOFTWARE.COM

There are a huge number of problematic settings in Windows, from Microsoft's Advertising ID and system information uploads to the sharing of handwriting data and Cortana searches. ShutUp10 gives you one easy console to shut them all down at once, without having to dig through various settings menus and registry edits. It gives a huge list of potential privacy issues and lets you select which ones to switch (with some sensible recommendations in place as well).

Recommended alternative: W10Privacy (**www.winprivacy.de**), has a similar feature set to ShutUp10, but also includes a clear description of what each option does (as well as the potential downsides of switching it off).



BEST TOOL FOR CLEANSING INFO FROM YOUR SYSTEM

CCleaner

CCLEANER.COM

Although a lot of the best features are now going into the paid version of CCleaner, the free option still has a tremendous amount to offer. CCleaner goes through your system and rips out the crud: you browsing history, cached files, recent documents, unused registry entries, temporary files and quite a bit more. It's a great tool for giving your system a refresh or covering your tracks.

Recommended alternative: Glary Utilities (**www.glarysoft.com**), which has a host of useful tools built into it, includes a file shredder to prevent recovery of deleted files. A useful one-stop shop for cleaning your system.

BEST TOOL FOR BLOCKING ADS

uBlock Origin

GITHUB.COM/GORHILL/UBLOCK

Available as an add-on for most popular browsers, uBlock does a great job of filtering out the ads from most sites, including video streaming sites like Twitch and YouTube. It's free and open source, and doesn't have some of the more questionable business practices of some of its competitors.

Recommended alternative: Adguard (**adguard.com**) is a DNS-based filtering tool. For Windows, we'd just use a browser-based solution like uBlock Origin, but on mobiles AdGuard is great, even when using a VPN cheat to block ads found in apps.

How to choose and test a VPN service

There are several factors to consider when you're choosing a paid VPN. Adam Marshall divulges his best tips on finding the right one for your needs.

1 Does the plan have servers in every country and region you require? Having more than one server in a country can help spread the load, but doesn't guarantee improved performance, so don't assume a plan with 500 servers will automatically beat another with 100.

2 Check the number of simultaneous connections supported. Typically, this is 3-5, which allows you to have a PC, mobile and tablet connected at the same time. But beware, many companies say this is for a single user only, and they all have fair usage policies to prevent people hogging resources. If you let the entire family download and stream videos separately then you'll run into trouble.

3 Some providers list the connection protocols they use. OpenVPN and IKeV2 are good choices, fast and secure. You might see SSTP and the older PPTP, as well as protocol options (TCP or UDP for OpenVPN). You don't need to understand the low-level details, but having the extra choice can help the service make faster and/or more reliable connections.

4 All VPN companies say they don't log whatever you're doing online, but inevitably they collect a little data. Some services record the day your account logged on, the amount of data you used, and delete anything else when the session closes. Others add items like your incoming IP address and the server you used, and keep the data for months or years. If you're concerned, check the Privacy Policy and Terms of Service to know more.

5 It's important to consider the client, the software which handles your connections. These all have a list of servers and a Connect/Disconnect button, but could you use more? Some clients display server load and ping time in the interface, helping you choose the right server.

ACCESS TO WEBSITE DISABLED
You have attempted to obtain access to a particular website. This page notifies you that access to that website has been disabled because the Federal Court of Australia has determined that the website infringes, or facilitates the infringement of, copyright.
Many sites related to peer-to-peer piracy are now blocked in Australia.
internode

Regular users might appreciate a 'Favourites' system to save and recall specific servers. If you know what you're doing, having access to low-level network settings will help you tune the whole system.

6 Finally, there's the price. Beware of apparently cheap deals: these may have restricted features, exclude taxes, be discounted for the first billing period only, and renew automatically, so that apparent one-off US$3.99 might become almost US$15 next month. Look for a 'Pricing' link, read the small print, and if possible use something like PayPal where it's easy to check and cancel a subscription yourself.

Once you've found what looks like a good VPN candidate, be sure to give it a trial before you spend big money. But a short trial can only tell you so much, so once that's expired, pay for a month, run as many tests as you can, then upgrade to a better value plan (usually yearly) if you're happy.

HOW WE ASSESS VPNS (AND HOW YOU CAN TOO)

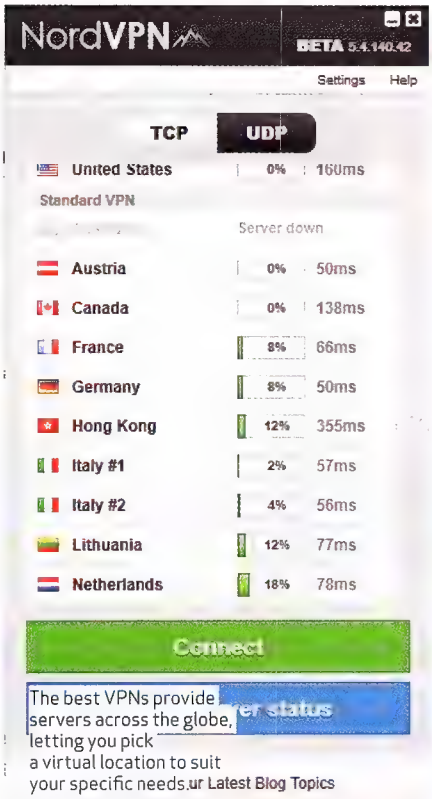
When reviewing VPNs, we start by looking at a provider's range of plans. We're looking for features, value, and clear and honest pricing. Free ways to learn more about a service – free plans, trial periods, refund periods – are important, and we also look for companies which maintain your privacy when you sign up (such as not requiring an email address, trials being made available without credit cards, and Bitcoin available as a payment option).

The official product pages never tell you everything you need to know, so head off to the Privacy Policy and Terms and Conditions pages to find the real details. Does the company log more data than you'd expect, or keep it for a long time? When might it share information with others? Are there any restrictions on who can sign up? (Some providers say you must be 18 or over, or that the service is for personal, non-commercial use only.) Any other catches?

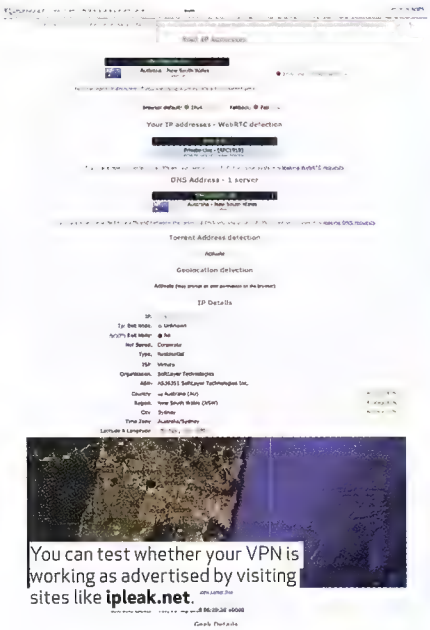
VPN performance is difficult to measure as there are so many variables, but we use multiple techniques to try and get a feel for each service's abilities. We first use **speedtest.net** to measure the latency, upload and download speeds for a distant connection (typically Australia to California), then repeat the test immediately with the VPN turned off, and look at any changes.

We follow this up with a much shorter connection (typically Australia to Hong Kong) to see a more typical peak performance, run a second benchmark to confirm our results, and run some general browsing tests – including streaming HD video – to look for other problems. VPNs will always give you a new IP address, but some

"VPN performance is difficult to measure as there are so many variables, but we use multiple techniques to try and get a feel for each service's abilities."



The best VPNs provide servers across the globe, letting you pick a virtual location to suit your specific needs.

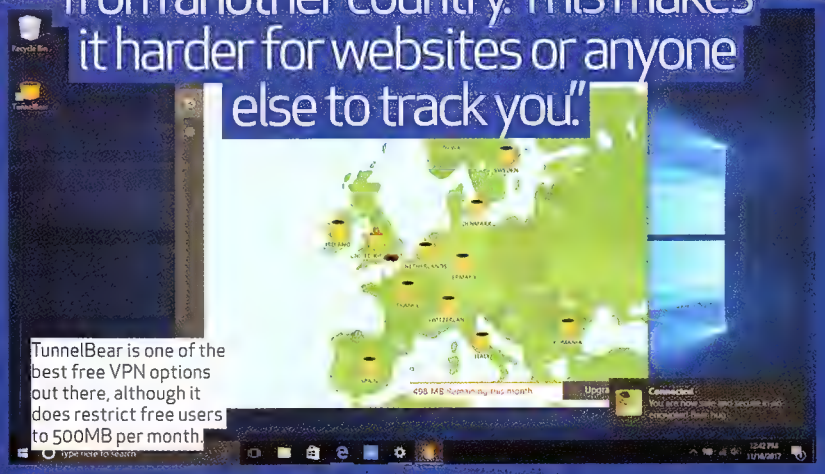


You can test whether your VPN is working as advertised by visiting sites like **ipleak.net**.

services may have DNS or other leaks which give clues about your identity. We visit **IPLeak.net** and other privacy sites to look for problems.

In terms of the client and interface, we look for good server selection tools (by country, region, server, speed, with filters, a Favourites system, perhaps with server load or ping time displayed), with plenty of configuration options, but also a client which stays out of the way until it's needed.

"VPNs also give you a new digital identity in the shape of an IP address from another country. This makes it harder for websites or anyone else to track you."



TunnelBear is one of the best free VPN options out there, although it does restrict free users to 500MB per month.

Free vs. paid VPNs: Which is better?

VPNs used to be a premium product, but you don't have to spend big money on them anymore.

Some companies now offer a basic service that won't cost you a thing. Are the free VPNs as good as their paid-for counterparts then? Not so fast.

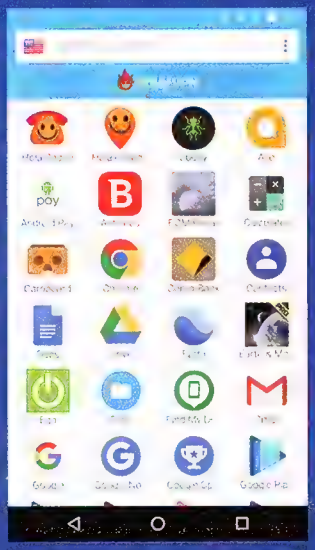
As you'd expect, there are catches, and they typically start with a data cap. Avira Phantom VPN's free plan limits you to 500MB a month, PrivateTunnel offers 2GB, whereas ZPN has a generous 10GB allowance — not bad at all.

Free products also typically have usage restrictions. Most companies don't want you to soak up all their bandwidth on torrents, so ZPN is typical in blocking P2P.

Hide.me's 2GB free plan also has some common limits. There's "best effort" bandwidth, which means paying customers have speed priority and you get what's left. And the choice of locations is limited to three: Canada, Netherlands and Singapore.

Hola's free-for-personal-use plan doesn't have the same kind of restrictions, but even here there's a catch. The service routes traffic through its free users rather than dedicated servers, so signing up allows others to (securely) share a small part of your bandwidth and resources.

Then there's the adverts and the session limits and the general lack of service level agreement: free means that it doesn't come with any implicit warranties.



The famous (or infamous) Hola Free VPN is a popular browser extension and mobile app, but one with a catch: it's peer-to-peer, so if you're a user you're also a potential server, which can chew up your bandwidth.

Free plans are fine for simple needs, then — maybe protecting your laptop's wireless hotspot traffic on the occasional trip — but if you're looking for anything more advanced, a commercial product is best.

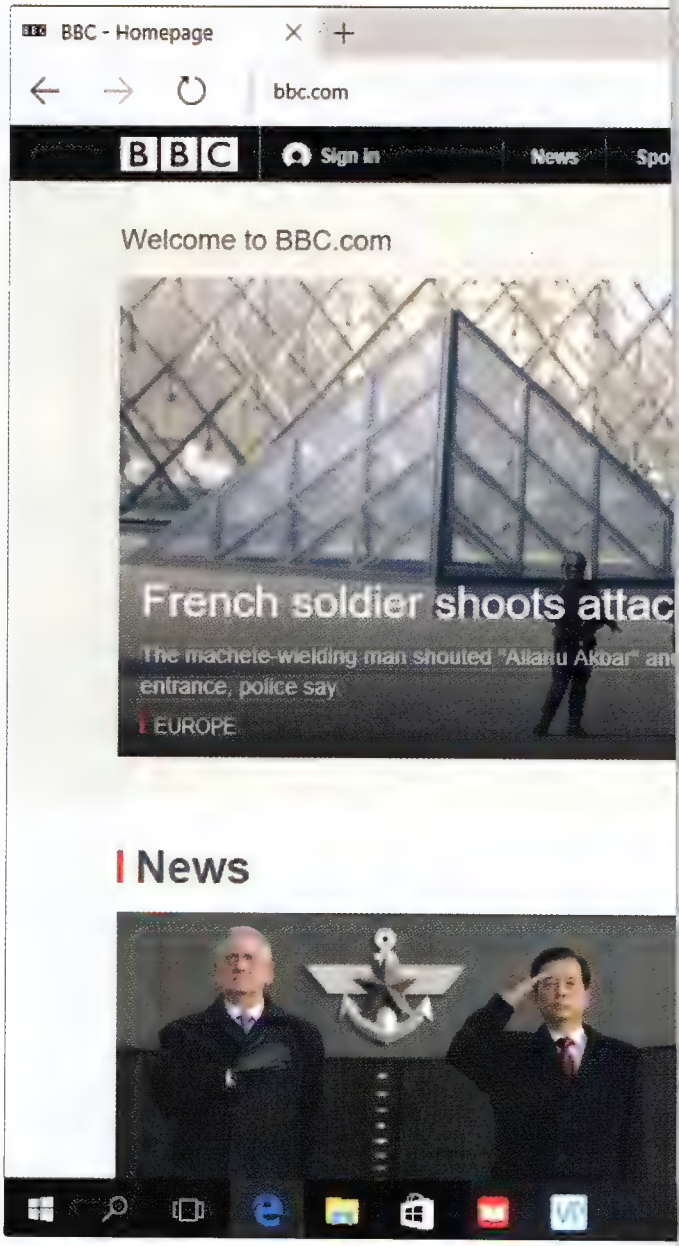
The immediate benefit is that you know your personal data remains safe, even if you're on a public Wi-Fi hotspot. Local snoopers might be able to see the connection, but there's no way to find out what it is or where it's going.

VPNs also give you a new digital identity in the shape of an IP address from another country. This makes it harder for websites or anyone else to track you, allows some people to bypass government censorship, and helps the rest of us avoid those "not available in your country" messages on YouTube or other streaming sites.

Best of all, despite the low-level network technology involved, you don't need to be any kind of expert to make VPNs work. For the most part, all you have to do is choose the country where you'd like an IP address, click Connect to start, Disconnect when you're done — and that's it.

Block web trackers

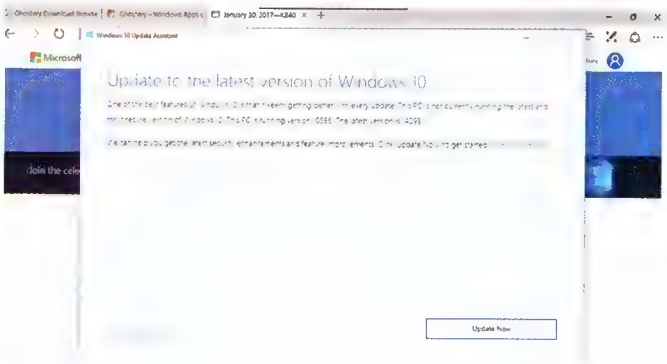
Nate Drake explores how to use the Ghostery browser extension and protect your privacy when surfing online.



Many websites you visit are tracking you through placing small files named 'cookies' on your computer. This helps them gather information about your browsing habits and target you with adverts. Data collection tools (known as 'trackers') can be very intrusive. If you wanted a quote for life assurance for instance, would you want an insurance website to know that you'd been browsing books on Amazon about quitting smoking?

Luckily, a Microsoft Edge browser extension called Ghostery can help stop you from being tracked online, blocking communications with such companies while still enabling you to surf the web. Better yet, it displays a handy purple list of companies that have tried to track you, as well as what information they're after. Install it today to make sure your web history stays private and keep monitoring it regularly.

Install Ghostery

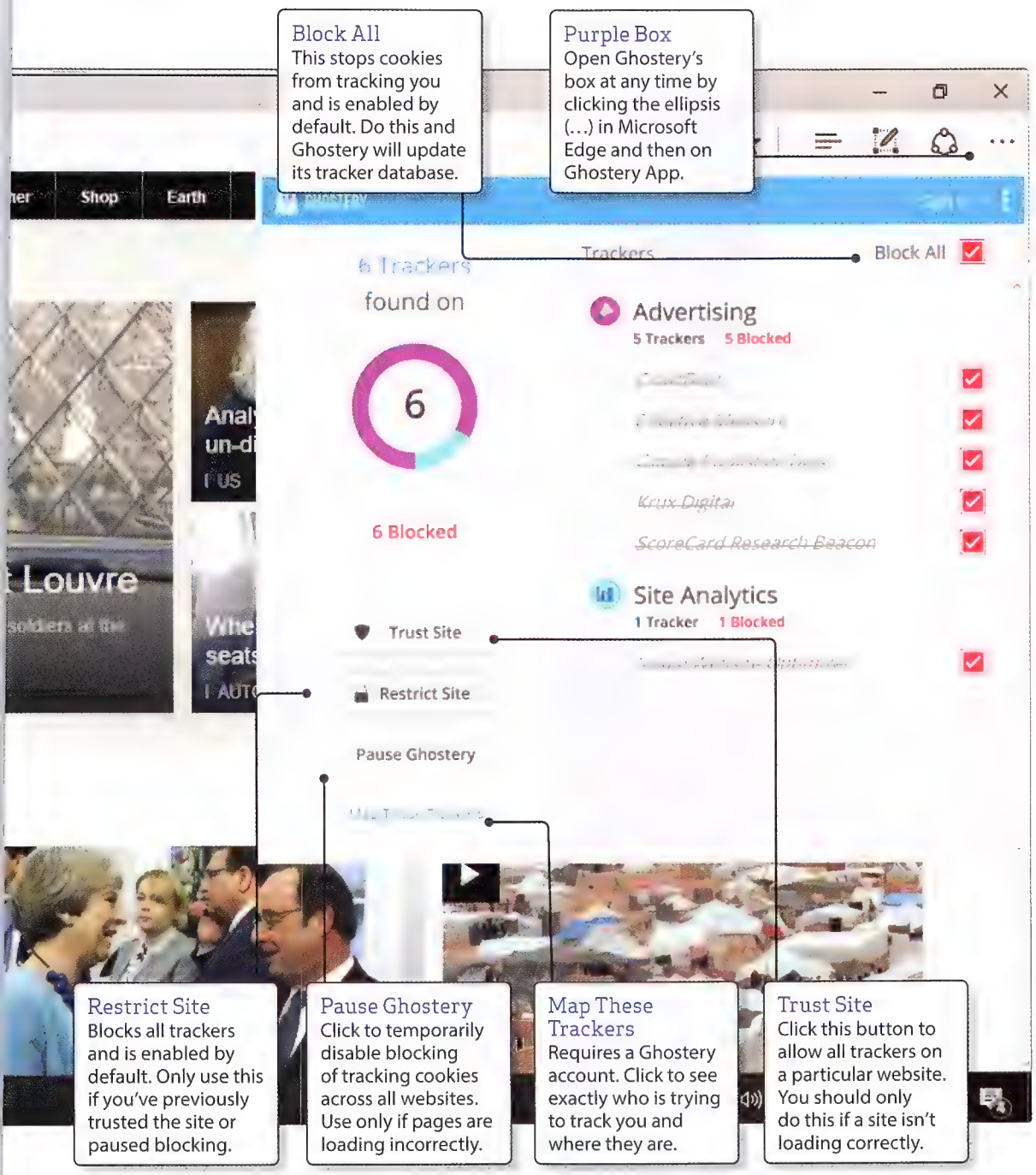


1 UPDATE WINDOWS 10

Ghostery needs the most recent version of Windows to work. Save and close any open files and back up your data if possible. Next, click the search button at the bottom left of your desktop, then enter Windows 10 Upgrade Assistant. Click the desktop app to open. Click Yes to confirm that you wish to open the app, then 'Update Now' to begin upgrading your system.

2 VISIT THE GHOSTERY WEBSITE

Once the update is complete, open Microsoft Edge and visit **www.ghostery.org**. Hover your mouse over 'Our Solutions' and click on 'Ghostery Browser Extension'. A new screen will appear listing various web browsers. Scroll down until you see Microsoft Edge. Click 'Add to Edge' and the Microsoft Store will open. Quit Microsoft Edge, then click the button marked 'Free' to install.

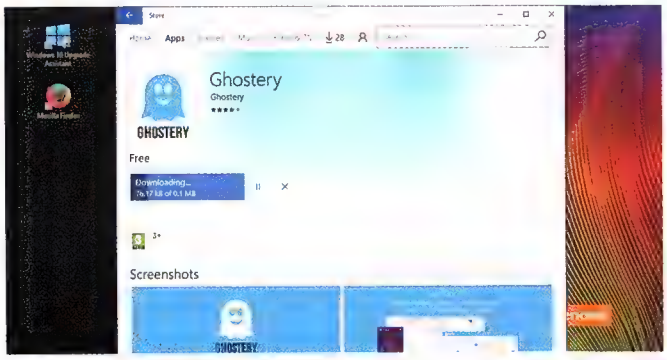

Block All
This stops cookies from tracking you and is enabled by default. Do this and Ghostery will update its tracker database.
Purple Box
Open Ghostery's box at any time by clicking the ellipsis (...) in Microsoft Edge and then on Ghostery App.
Trackers
Block All
6 Trackers found on
6
6 Blocked
Advertising
5 Trackers 5 Blocked
Site Analytics
1 Tracker 1 Blocked
Trust Site
Restrict Site
Pause Ghostery
Restrict Site
Blocks all trackers and is enabled by default. Only use this if you've previously trusted the site or paused blocking.
Pause Ghostery
Click to temporarily disable blocking of tracking cookies across all websites. Use only if pages are loading incorrectly.
Map These Trackers
Requires a Ghostery account. Click to see exactly who is trying to track you and where they are.
Trust Site
Click this button to allow all trackers on a particular website. You should only do this if a site isn't loading correctly.

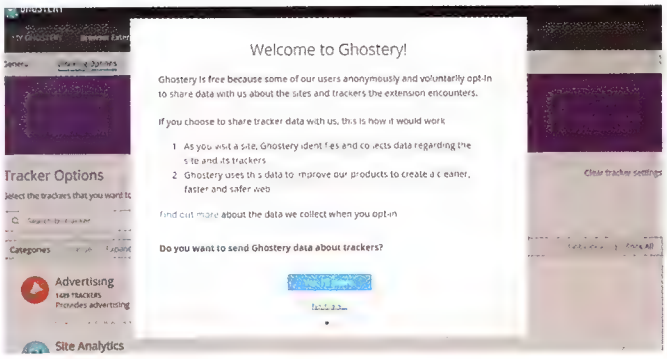
Jargon buster!

Browser extension
A piece of software, such as Ghostery, that is designed to extend the function of your browser. Only install from trusted sources such as the Microsoft Store.

Cookies
A small piece of data used by third parties to identify you. Cookies are usually downloaded and stored by your browser. Ghostery prevents this.

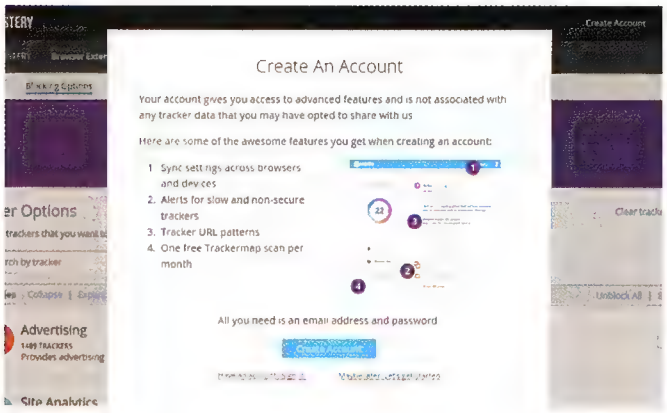
Blocking cookies
Some web browsers include an option to block cookies altogether. Some sites may not load if you do this, which is why it's better for you to use Ghostery.





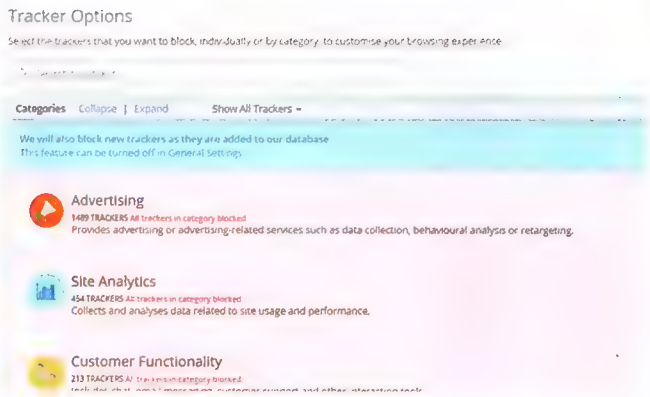
3 BEGIN GHOSTERY DOWNLOAD
At this stage Ghostery may ask you to confirm your date of birth and region. Enter this and click Next. The Microsoft Store will say 'Acquiring Licence', then Downloading. The Ghostery extension is small (0.1MB) so this won't take long. Finally the Store will tell you that the product has been installed. The button below the Ghostery logo will now read 'Launch'. Click this to open Edge.

4 WELCOME TO GHOSTERY
A notification will appear at the top right explaining that Ghostery has been installed. You still need to activate it, so click 'Turn it on'. You'll now see a 'Welcome to Ghostery' splash screen when Ghostery will ask you if you wish to share data about trackers you encounter while browsing. This is optional but helpful to detect new threats. Choose Yes or No as you see fit.


Create An Account
Your account gives you access to advanced features and is not associated with any tracker data that you may have opted to share with us
Here are some of the awesome features you get when creating an account:
1. Sync settings across browsers and devices
2. Alerts for slow and non-secure trackers
3. Tracker URL patterns
4. One free Trackermap scan per month
All you need is an email address and password

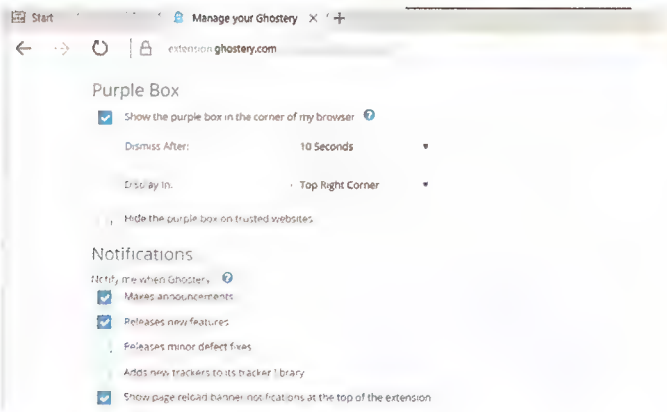
5 CREATE AN ACCOUNT

Ghostery now displays the 'Create an Account' window. You don't have to do this but it allows access to extra features, such as syncing settings across your devices. You're also allowed one free trackermap scan per month to help you locate companies that are tracking you across the Internet. If you don't want to create an account right now then click 'Maybe later, let's get started'.


Tracker Options
Categories
Collapse | Expand
Show All Trackers
We will also block new trackers as they are added to our database
This feature can be turned off in General Settings
Advertising
Provides advertising or advertising-related services such as data collection, behavioural analysis or retargeting.
Site Analytics
Collects and analyses data related to site usage and performance.
Customer Functionality

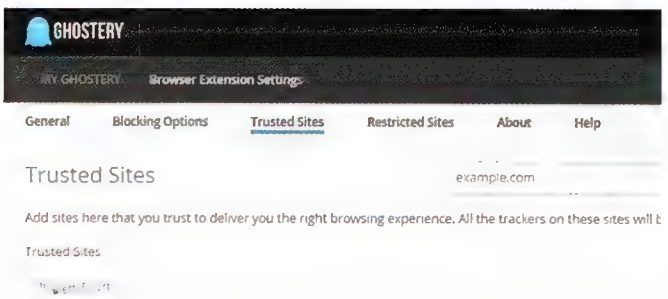
6 CHOOSE YOUR TRACKER OPTIONS

Ghostery will next launch the main Tracker Options window. Scroll down to see various types of trackers which Ghostery can detect such as Advertising and Social Media. The easiest option for now is just to click 'Block All' to ban all trackers. If this causes issues later, you can return to this screen by clicking on the More option in the Ghostery Box and then 'Advanced Blocking'.


Manage your Ghostery
Purple Box
Show the purple box in the corner of my browser
Dismiss After:
10 Seconds
Top Right Corner
Hide the purple box on trusted websites
Notifications
Makes announcements
Releases new features
Releases minor defect fixes
Adds new trackers to its tracker library
Show page reload banner notifications at the top of the extension

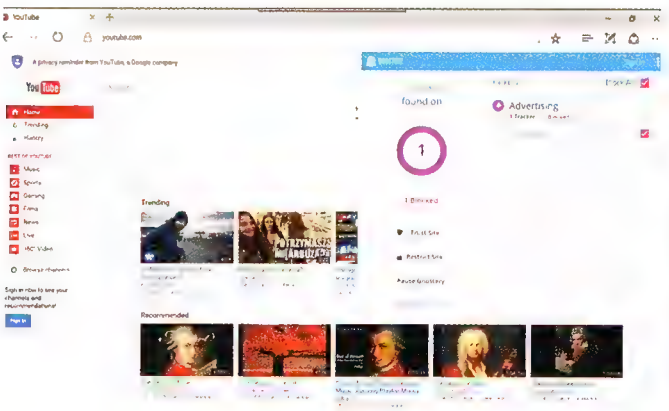
7 CHOOSE WHAT TO BLOCK

Click on the word General next to Blocking Options. Most of these options can be left ticked. However you may wish to scroll down to the Purple Box section. By default Ghostery displays a small box for a short time when you visit a new site listing all the trackers that have been blocked. You can switch this off or change the duration (default is 15 seconds) and position of the box here.



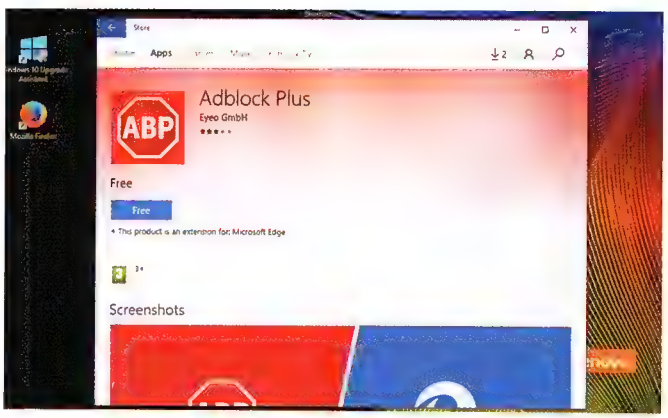
8 CONFIGURE TRUSTED SITES

Although you can visit sites individually and click Ghostery's Trust Site button, it's easier to set this up here. Click the 'Trusted Sites' option at the top of the page. Once it loads, enter the name of the website in the white bar at the top, then click on the green + button. Repeat for any websites you fully trust. Hover over a website and click the X to remove it from this list at any time.



9 TEST PILOT GHOSTERY

Once Ghostery has been set up. Click the address bar at the top and visit a social media or news site to check that everything is in order. If the purple box doesn't appear click the ellipsis (...) button at the top right of the Edge window then Ghostery App to view any blocked trackers. You can enable individual trackers here or choose to trust the entire site, allowing all cookies.



10 INSTALL AN AD BLOCKER

Although Ghostery can prevent websites from tracking you, it can't stop all pop-up ads or those annoying ads that load when you're trying to watch YouTube. Fortunately Adblock Plus is also available for Microsoft Edge. Open the Microsoft Store and search for its name, then install. This reduces the chance that you'll inadvertently click a link and download malware. ■

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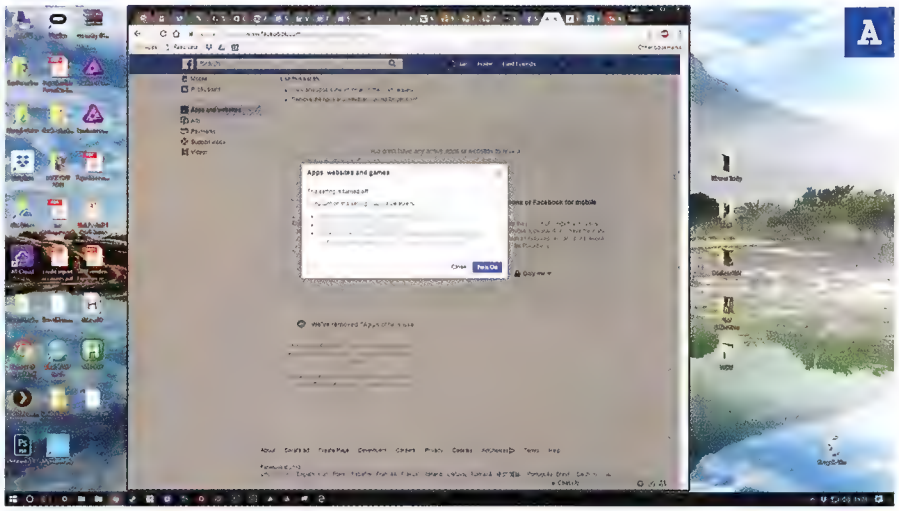
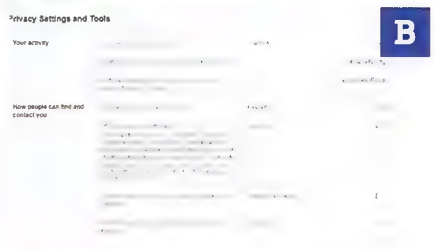
Increase your Facebook security

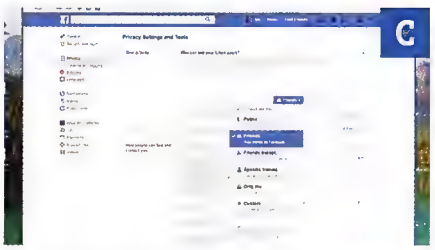
Ian Evenden details what settings to change to make your account safer.

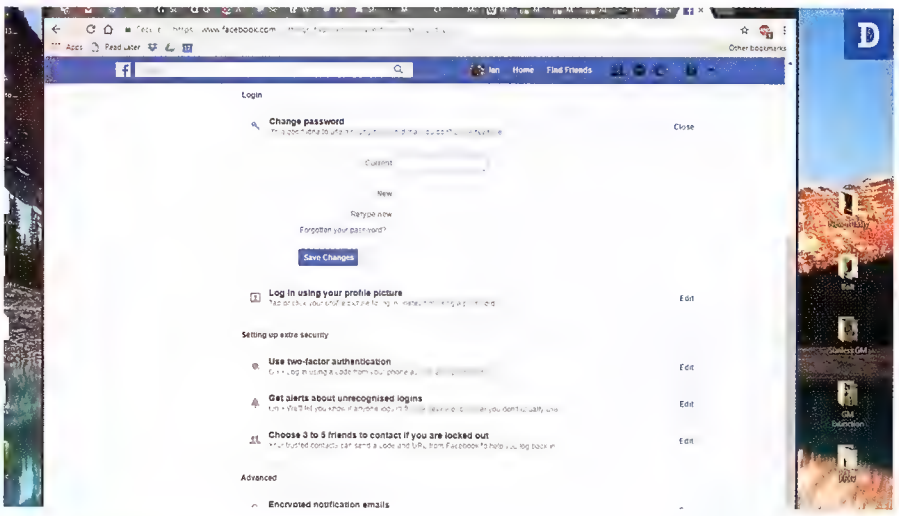
There's a lot of concern about online privacy nowadays, particularly on Facebook in the light of the Cambridge Analytica scandal, in which personally identifiable data on over 87 million Facebook users was collected without their consent – if it's not your friends guessing your password and posting hilarious jokes under your name, it's the more sinister abuse of your personal information.

There are steps you can take against these intrusions, both on Facebook and on the wider web. The latter boils down to making sure your passwords can't be guessed, worked out through social engineering, or put together from multiple sources. They need to be long, too, so a brute force attack – which tries multiple passwords extremely quickly – takes much longer to work through the permutations. No using your date of birth or the name of your cat, either, unless you know the secret name Mr Tickles only tells other cats.









1 DISABLE PLATFORM

The nuclear option. Turning off Platform prevents the integration of Facebook with apps and games, disables the ability to log into websites using your Facebook ID, and stops friends' Facebook apps accessing your personal information. Turning Platform off might be inconvenient, but its security benefits are undeniable. Find it in Settings, under 'Apps and Websites' [Image A].

2 INCREASE PRIVACY

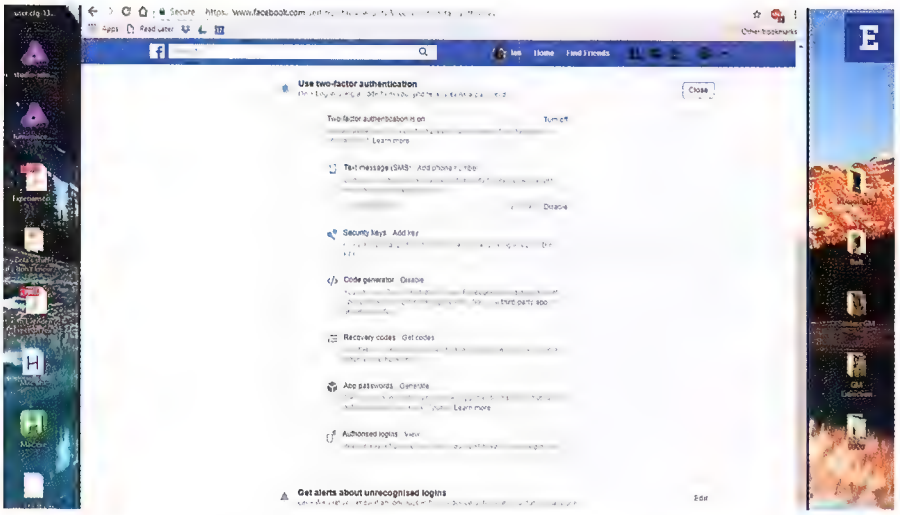
Facebook is finally clamping down on access to your data, but there's more you can do to hide things. Under Settings › Privacy [Image B], you can change who sees your posts, with several levels of control. 'Public' posts are just that – public. Anyone can see them. 'Friends' means only Facebook friends can see your posts, and you can control this further by excluding people.

3 LIMIT ACCESS

Still in Settings › Privacy, if you want to stop specific people seeing your posts, you can [Image C]; you can also specify friends who can see your posts while excluding everyone else. There's also 'Only Me', which restricts the visibility of your posts to just you. It makes Facebook awfully quiet, but is the most private you can get. There's an array of custom settings, too.

4 PRIVACY CHECK-UP

One way to check your privacy settings is to use the Privacy Check-up feature, found by dropping down the



E

F

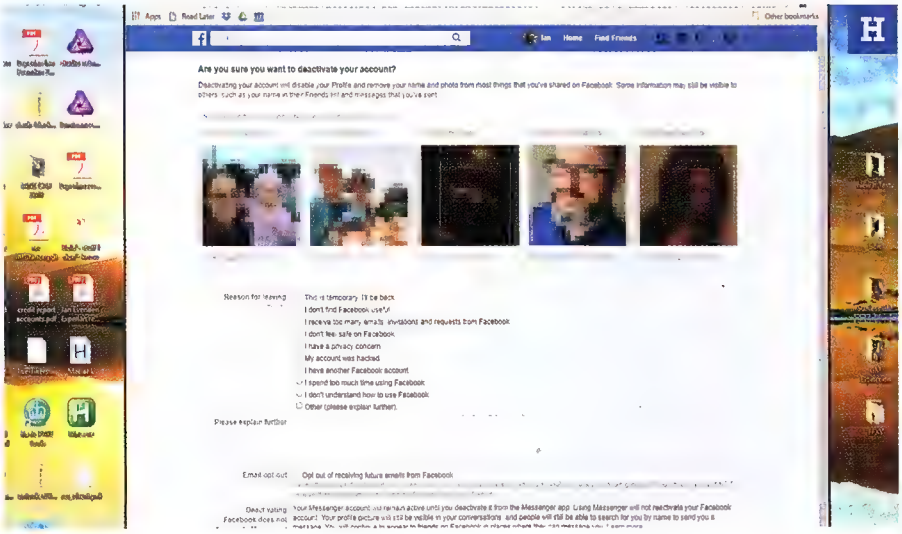
G

> "Facebook is finally clamping down on access to your data, but there's more you can do to hide things."

question mark menu at the top-right of Facebook's interface. This takes you through common settings, including whether those people who can see when your birthday is can also see the year you were born. There's also a shortcut to the privacy settings.

5 CREATE A STRONG PASSWORD

The key to a strong password is creating something you will remember but no one else can guess. Long strings of random characters are tricky to commit to memory, but a password made up of three words is much easier to recall: "Horse Duck Gibbon," for example. Extra capital letters and a number on the end decrease the chance of cracking it. The longer you can make it, the better [Image D].


Are you sure you want to deactivate your account?
Reason for leaving
Please explain further
Email opt out
Opt out of receiving future emails from Facebook

H

6 USE TWO-FACTOR AUTHENTICATION

Two-factor authentication involves a message being sent to your mobile after you have entered your username and password, with a code that you then type into the website to verify that it's actually you. It means trusting the site in question with your phone number, but if someone guesses your password, they're unlikely to have stolen your phone, too, and this tips you off about any login attempts [Image E].

7 USE A PASSWORD MANAGER

Password management apps – such as 1Password, Keeper, and True Key – sit between you and the website you're logging in to. They generate and store your passwords – strong, long, random sequences that you might struggle to recall but apps have no problem remembering. When you log into the management app, it supplies the password directly to the site. They usually require a monthly subscription, though.

8 DELETE APPS YOU DON'T USE

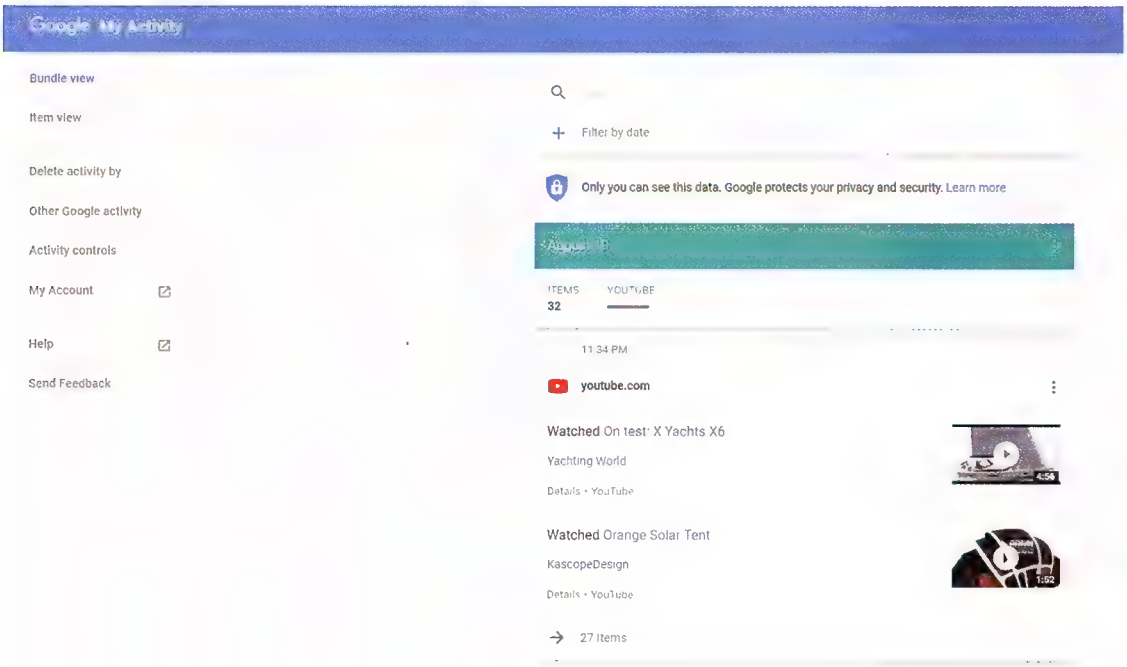
Under 'Settings > Apps and Websites', you'll find a list of apps and sites you've approved for access to your Facebook account. If you no longer use – or don't recognise – any of them, you can revoke their access or edit the kind of data they have access to [Image F]. Also check the Expired tab for apps you may not have used recently, and which can no longer make requests for data.

9 LOG OUT WHEN FINISHED

It may sound simple, but this is one of the best security measures you can take, especially if you share your PC with others. Logging out [Image G] puts an obstacle in the way of those who would use your social media accounts for evil, particularly the jokers who send messages in your name. Of course, if you've set your browser to remember your password, then logging out is no defence at all.

10 DEACTIVATE YOUR ACCOUNT

If you're considering ditching Facebook completely, but aren't quite sure, this is the alternative. Deactivation is not the same as deleting – if you ever log back into Facebook, perhaps when redirected from another site, your account will reactivate, and pop back up again, just as it was when you deactivated it. To do it, head to Settings > General. Click Edit next to 'Manage Account', then 'Deactivate your account' [Image H]. One more click, and you're free. ■



Google does let you get a view of everything it has recorded about you.

Improve the privacy of your Google account

Nathan Taylor explains how to stop the search engine from tracking your online activity.

Unless you've been extra careful, it's fair to say that Google knows you just about as well as you know yourself. The internet giant hoovers up vast amounts of information on millions of users, ostensibly to deliver better ads (or, more accurately, to sell that user information to advertisers in order to better target ads).

This is especially true if you have a Google account. When you're logged into your Google account, Google will keep a permanent record of:

- Every search term you type into Google
- Every search result you click on
- Every YouTube search you perform and every video you watch
- Ads you click on
- A complete timeline of your movements by tracking your mobile's GPS
- Every time you issue an 'OK Google' voice command
- Potentially any time you visit a page with embedded Google services (like maps) and your complete Chrome browser history (thankfully this last one is turned off by default).

This information is recorded and attached to your personal Google account permanently. But even if you don't have a Google account or are not logged in, it will still gather information.

It records the IP addresses of people searching with Google and what they searched for. This data is kept for a period of time before being "anonymised" by deleting part of the IP address.

Its DoubleClick, AdSense and AdMob ad networks use tracking cookies and similar techniques to monitor app usage and movement between sites, too.

To its credit, Google does now give you tools to switch a good deal of that account tracking off — and that's more than can be said for some of its competitors, such as Microsoft and Facebook. We'll walk you through that process below, as well as give some extra tips for dodging Google's tracking.

Google Maps forever

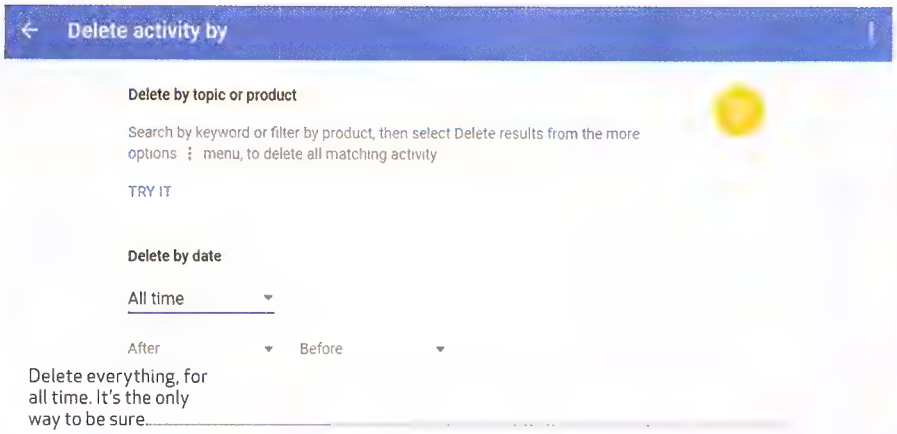
Unfortunately, you can't currently disable all of Google's location tracking

Even with location tracking for your account disabled, Google has recently disclosed that it will still store information about a user's location via some of its services, including Google Weather, Search and Maps. This means, essentially, that turning Location History off just hides the visibility of your location timeline from yourself, even though that data still remains stored on Google's servers. As that adds up to a somewhat fruitless endeavour, we'd therefore recommend leaving your Location History turned on — because at least that way you can see what information is being kept on you.

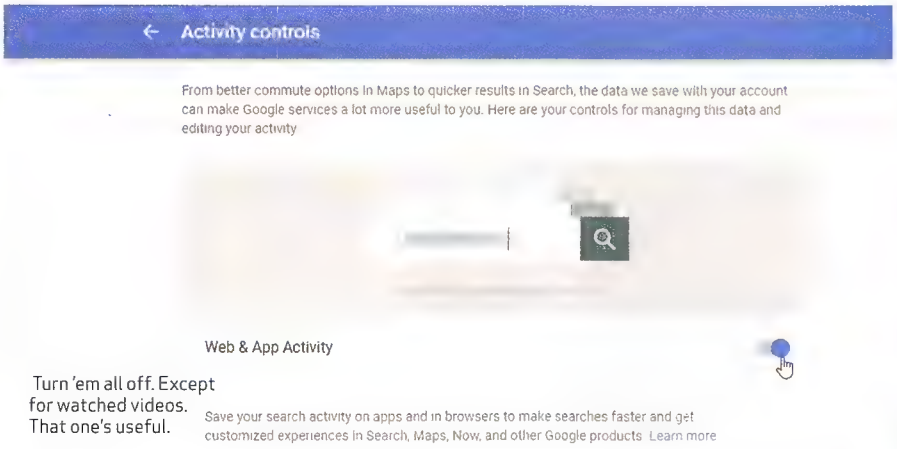
DISABLING TRACKING AND RECORDING

Google, thankfully, gives you the tools to delete your account records permanently, as well as turn off future tracking. You just have to know where to find the settings. Head to **myactivity.google.com** and log in. It's here that you'll see the every bit of data Google has associated with your account, plus you can delete your records and stop further tracking.

The first thing you want to do is delete the archives. This will remove every item


Delete activity by
Delete by topic or product
Search by keyword or filter by product, then select Delete results from the more options ⋮ menu, to delete all matching activity
TRY IT
Delete by date
All time
After
Before

Delete everything, for all time. It's the only way to be sure.


Activity controls
From better commute options in Maps to quicker results in Search, the data we save with your account can make Google services a lot more useful to you. Here are your controls for managing this data and editing your activity
Web & App Activity
Save your search activity on apps and in browsers to make searches faster and get customized experiences in Search, Maps, Now, and other Google products Learn more

Turn 'em all off. Except for watched videos. That one's useful.

from Google's record about your activity. Now, we need to say up front that we pretty much have to take it on faith that Google is actually deleting these records. The company has said that it does, although it notes that, in some cases, the records may still be stored on (offline) backup tapes and in archives.

Click on 'Delete activity by' on the left side of the page. Then under 'Delete by date', select 'All time' from the drop-down menu and click Delete. This will clear the records of your online activity up until now. You'll be asked to confirm your choice.

Now it's time to stop Google from gathering data in the future. Go back to the My Activity page, then click on Activity Controls on the left. This is where you can switch off all the logging that Google does.

Here, you will see a set of panels for different types of activity that Google records. There are panels for 'Web & App Activity', 'Location History', 'Device Information', 'Voice & Audio Activity', 'YouTube Search History' and 'YouTube Watch History'. In each panel, there is a blue switch. With the exception of Location History (see the box at left for more on why), you'll want to turn them all off, which Google calls "paused". You'll get a warning pop-up for each one.

The other exception you might make is watched YouTube videos. That's actually useful, since it determines YouTube recommendations. Once you've done that, Google should stop recording your activity in your Google account. It does not stop IP logging of searches (we'll get to that), and it will still keep some search information in cookies for the duration of a session, but your permanent account activity record will remain clean.

ANTI-COOKIE MEASURES

Now to stop the tracking that Google does regardless of your account settings or login status. First up, let's stop those cookies and analytics.

The best way to do that is with a privacy add-on for your browser. There are a number that get the job done, but we've always liked Disconnect (**disconnect.me**). Another solid solution is Ghostery (**www.ghostery.com**). Installing these browser add-ons will block all tracking cookies from being sent by your browser. They also stop analytics and other tracking systems, like Facebook and Google widgets, from reporting your activity back to the mothership.

If you really want to kill ad tracking, you can also install uBlock Origin (**www.ublock.org**, which we now prefer to Adblock Plus) which will stop your browser from communicating with ad services like DoubleClick altogether.

DODGING IP LOGGING

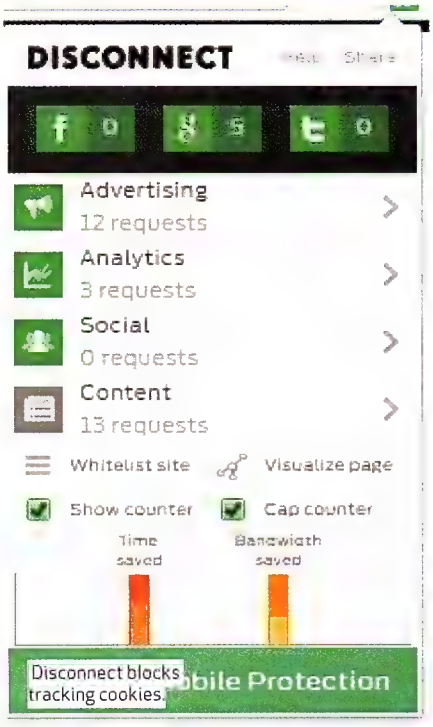
Finally, to deal with the fact that Google still links online searches with IP addresses, you can use a third-party search engine. If you still want Google's search results, we recommend **startpage.com**. StartPage still gives you Google Search results. Except that it fetches those results for you like a proxy, so that you don't give Google your IP address. StartPage itself claims that it logs no IP addresses or search terms – but again, we take that on faith.

With all Google account tracking turned off, with ad cookies and analytics disabled, with Google widgets blocked and by using a third-party search engine, you should now be mostly clear of the Google octopus. ■

Disabling third-party cookies

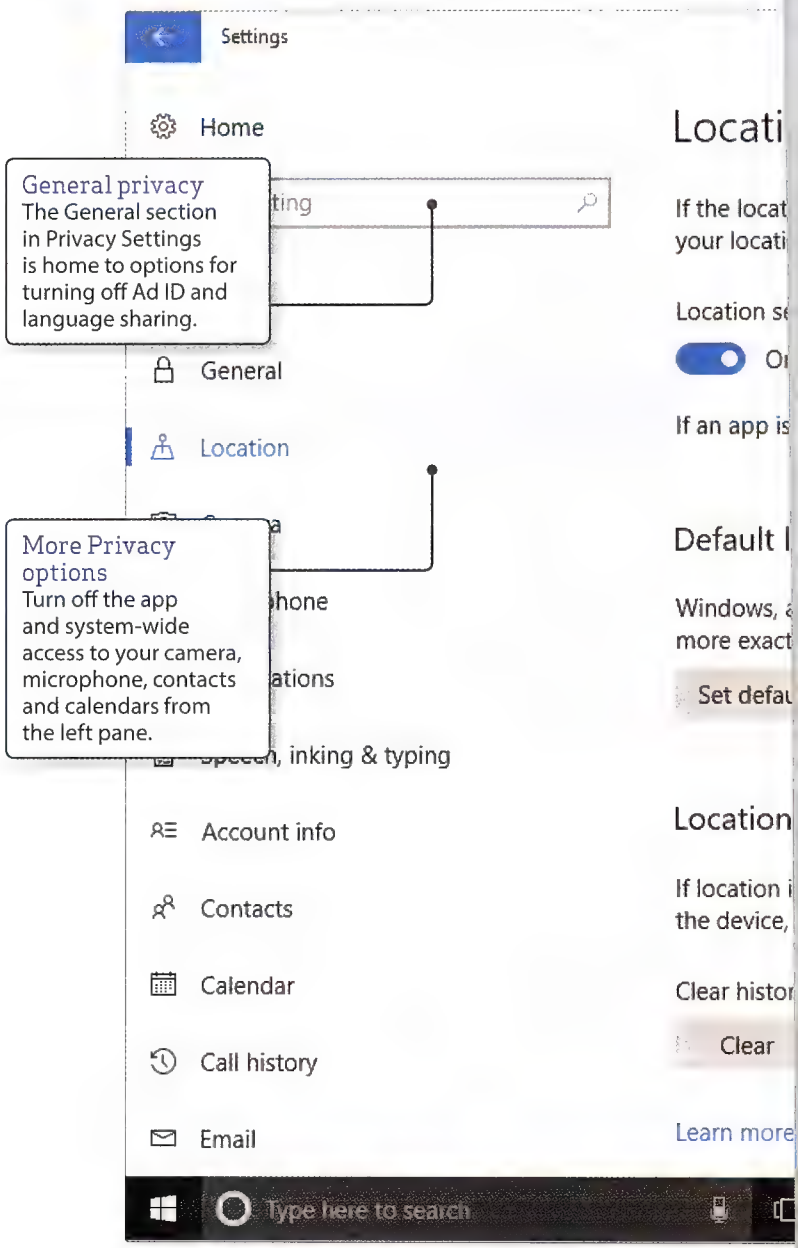
Another thing you can do to stop ad cookies is disable third-party cookies in your browser – though installing Disconnect or Ghostery has much the same effect

In Safari, they're actually disabled by default. In Chrome, you'll have to go to Settings > Advanced > Privacy and Security/Content Settings > Cookies to find the switch to turn off third-party cookies. In Firefox, you have to go to Options > Privacy and select 'use custom settings for history' to see the option to disable them. In Edge, go to Options > Settings > Advanced Settings and select the option to Block on 'Third Party Cookies' under Cookies.



How to stay private in Windows 10

Microsoft gathers your data — here's how to cut the cords.



Privacy is a hot topic these days. The rise of cloud-based services has seen more users than ever trust their private information to remote servers, at a time when the security of online data has come into question following a spate of high-profile breaches.

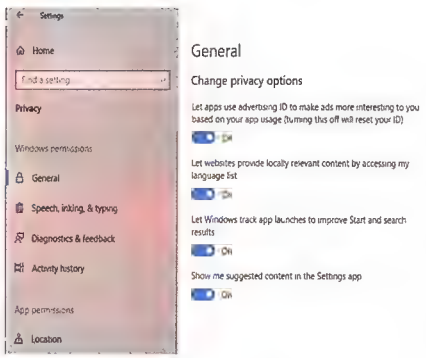
What does this have to do with Windows 10 users? Well, it might surprise you to learn in Microsoft's Privacy Statement, the company makes clear its intention to collect your data when you "create a Microsoft account, submit a search query to Bing, speak a voice command to Cortana, upload a document to OneDrive, or contact us for support".

However, if you'd rather not hand over your private data, don't worry — it's not too late to roll back these changes. We'll run you through some steps to help you take back your privacy in no time.

Reclaim your Windows privacy

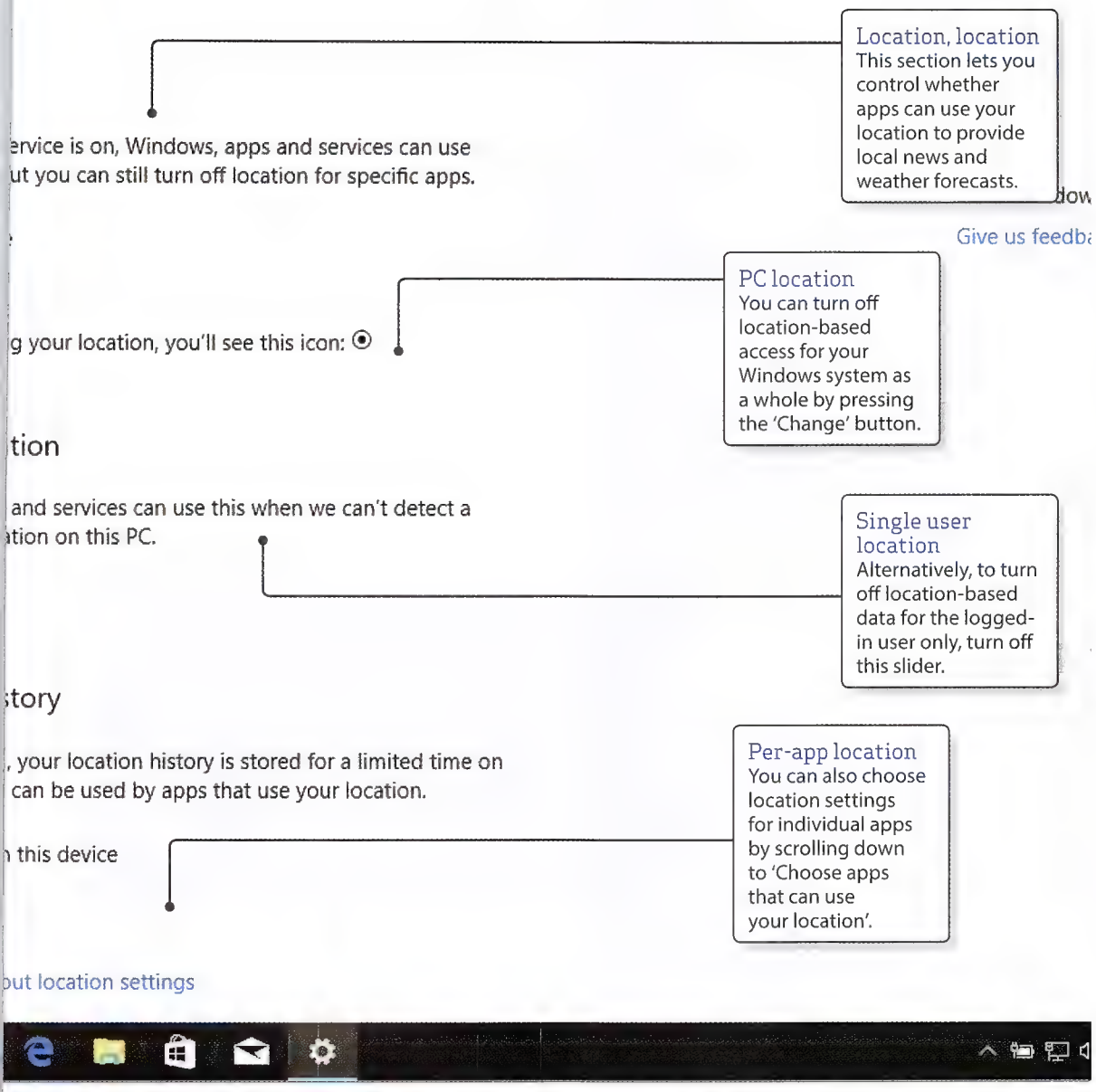
1 AD PERSONALISATION

Personalised ads are a form of targeted marketing that companies use online. When you visit a website for the first time, a 'cookie' is downloaded to your PC — a small text file of viewing data that the site uses if you ever return, so that it can tailor the ads you see. Happily, Windows 10 makes advertising personalisation optional by integrating it into its privacy settings.


Settings
Home
Privacy
General
Speech, inking, & typing
Diagnostics & feedback
Activity history
Location
General
Change privacy options
Let apps use advertising ID to make ads more interesting to you based on your app usage (turning this off will reset your ID)
Let websites provide locally relevant content by accessing my language list
Let Windows track app launches to improve Start and search results
Show me suggested content in the Settings app

2 DISABLE ADS IN WINDOWS

Disabling personalised ads in Windows 10 is a two-step process. First, go to Settings then navigate to the Privacy > General panel via the left-hand column and slide off the button next to the option 'Allow apps to use Advertising ID to make ads more interesting to you based on your app usage (turning this off will reset your ID)'.


ervice is on, Windows, apps and services can use
ut you can still turn off location for specific apps.
dow
Give us feedba
g your location, you'll see this icon:
tion
and services can use this when we can't detect a
ation on this PC.
story
, your location history is stored for a limited time on
can be used by apps that use your location.
this device
out location settings

Location, location
This section lets you control whether apps can use your location to provide local news and weather forecasts.

PC location
You can turn off location-based access for your Windows system as a whole by pressing the 'Change' button.

Single user location
Alternatively, to turn off location-based data for the logged-in user only, turn off this slider.

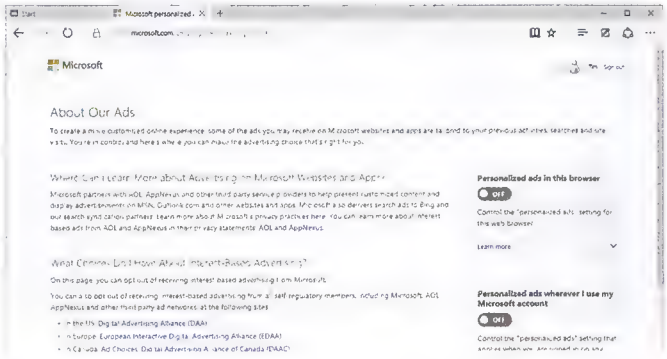
Per-app location
You can also choose location settings for individual apps by scrolling down to 'Choose apps that can use your location'.

Jargon buster!

Big Data
A broad term for any large or complex volume of data that cannot be processed using traditional methods.

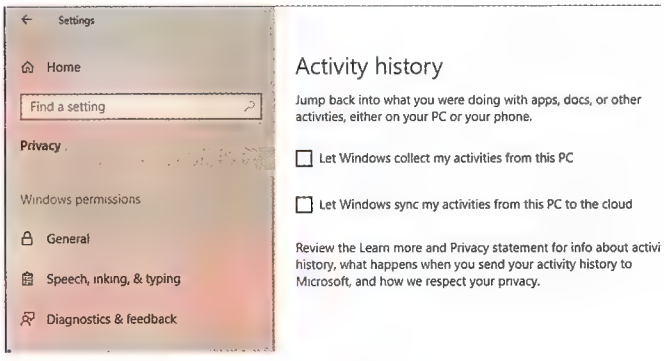
Cloud services
Any type of internet-based service that is available to users 'on demand', providing access to shared resources and data.

Identity theft
The deliberate use of someone's identity for criminal gain. Private data stored online is susceptible.



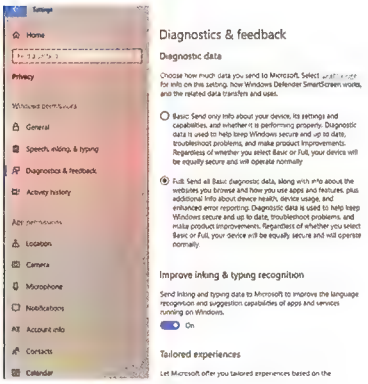
3 DISABLE ADS ONLINE

This step has to be carried out online, so open the Microsoft Edge web browser, type **choice.microsoft.com/en-us/opt-out** into the address bar and hit Enter. On the page that appears, select the Off buttons in the box under 'Interest-based ads: Microsoft account' and the box next to 'Interest-based ads: This browser'.


Settings
Home
Find a setting
Privacy
Windows permissions
General
Speech, inking, & typing
Diagnostics & feedback
Activity history
Jump back into what you were doing with apps, docs, or other activities, either on your PC or your phone.
Let Windows collect my activities from this PC
Let Windows sync my activities from this PC to the cloud
Review the Learn more and Privacy statement for info about activi history, what happens when you send your activity history to Microsoft, and how we respect your privacy.

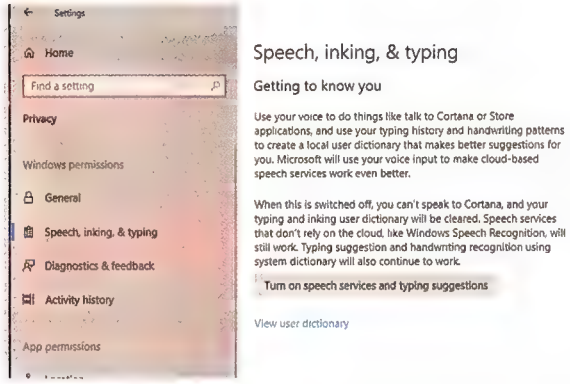
4 TURN OFF ACTIVITY HISTORY

Windows now keeps track of when and how you use your computer by default. This running timeline is used by Microsoft's AI to find patterns in your usage and does theoretically do some useful things, like scheduling updates at convenient times. This tracking can be optionally unchecked in the 'Activity history' section.



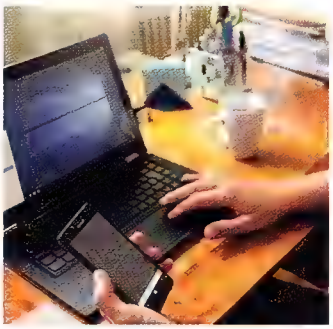
5 MINIMISE DIAGNOSTICS AND FEEDBACK

While Microsoft makes it seem like your data helps fix bugs, the 'diagnostic feedback' that you're volunteering is often more than just what's required to improve an application. In addition to diagnostic data if you select 'Full feedback' then "info about the websites you browse and how you use apps and features" is also sent to Microsoft. Switch the slider to Basic to avoid this.


Settings
Home
Find a setting
Privacy
Windows permissions
General
Speech, inking, & typing
Diagnostics & feedback
Activity history
App permissions
Speech, inking, & typing
Getting to know you
Use your voice to do things like talk to Cortana or Store applications, and use your typing history and handwriting patterns to create a local user dictionary that makes better suggestions for you. Microsoft will use your voice input to make cloud-based speech services work even better.
When this is switched off, you can't speak to Cortana, and your typing and inking user dictionary will be cleared. Speech services that don't rely on the cloud, like Windows Speech Recognition, will still work. Typing suggestion and handwriting recognition using system dictionary will also continue to work.
Turn on speech services and typing suggestions
View user dictionary

6 SPEECH, INKING AND TYPING

You can give Microsoft access to the microphone, keyboard and writing box so it can learn your language patterns to predict what you might want to say. If, however, you have no need for Cortana and/or you don't think predictive autofill features warrant access to your typing, then you can turn these features off in the 'Speech, inking and typing' section of the Windows privacy settings.

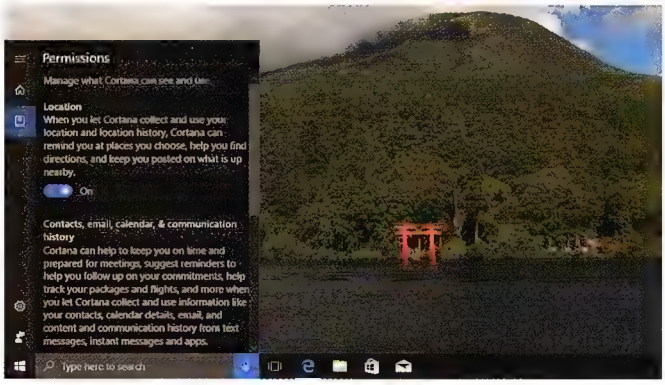


Reminders on all your devices

Need to buy flowers? Set a location-based reminder on a PC and it will show up on your Lumia when you're close to the store. Need to be somewhere at a particular time? Use Cortana to set a time-based reminder that shows up on all your Windows 10 devices. And with people-based reminders, Cortana can remind you to ask your friend something the next time they're

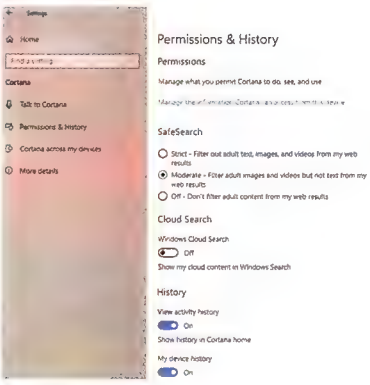
7 CORTANA DATA GATHERING

Cortana is Microsoft's digital personal assistant built into Windows 10. It's a useful feature that lets you create calendar events, send email, set up reminders plus a range of other actions. But to perform these duties it has to collect your data. If you've never used Cortana, then you have nothing to do, but if you do and you could live without it, here's how to turn it off.


Permissions
Manage what Cortana can see and use
Location
When you let Cortana collect and use your location and location history, Cortana can remind you at places you choose, help you find directions, and keep you posted on what is up nearby.
On
Contacts, email, calendar, & communication history
Cortana can help to keep you on time and prepared for meetings, suggest reminders to help you follow up on your commitments, help track your packages and flights, and more when you let Cortana collect and use information like your contacts, calendar details, email, and content and communication history from text messages, instant messages and apps.
Type here to search

8 GOODBYE CORTANA

Click the Cortana icon in the taskbar and then select the notebook icon on the left side of the menu. Choose Permissions. At the top is a slider for an option to let Cortana collect and use your location for more accurate searches; turn it off. Click on the Settings icon on the left side and there are further options to change or delete any information Cortana may have gathered.



9 BING SEARCH

Bing is Microsoft's answer to Google. It also collects data on your online activities, which then feeds into Cortana and other Windows 10 services. To turn it off, open Settings and go to 'Cortana > Speech and history'. Click the option to 'Clear my device history'. You can also then turn off 'My device history' and 'My cloud search' to prevent Bing from continuing to log your searches.

10 USING A LOCAL ACCOUNT

Using a local account in Windows 10 is a privacy-savvy way of limiting the system's access to the cloud. To set one up, go to 'Settings > Accounts > Your account', select the option to 'Sign in with a local account instead' and follow the wizard. Bear in mind that you'll lose access to any Windows features that are tied to your online Microsoft account, such as Windows Store. ■

COMPUTING WITH A DOUBLE HELIX

The molecule of life is being pressed into service for computing with some impressive and surprising results. Mike Bedford reveals how.

The silicon era has had a good innings. Since the dawn of silicon chips, we've seen memory increase in capacity by a factor of 128 million and processors become several billion times faster. Yet the writing is on the wall as semiconductor manufacturers now struggle to produce the ever smaller feature sizes needed to give us the year-on-year improvements we've grown to expect. It might be bit premature to sound the death knell for silicon anytime soon, and history suggests that most such problems have been solved sooner or later, but some scientists are taking no chances.

So, while electronics engineers are continuing to extract yet more performance from conventional silicon circuits, other researchers have their sights set on a host of revolutionary and unexpected technologies. Here we check out one potential new technology: computing with DNA.

Although we've become accustomed to computing being first and foremost about electronics, in one sense we shouldn't be too surprised that DNA is a potential successor. After all, this double helix molecule contains all the data necessary to replicate a human being and, in that sense, is a form of data storage. When we bear in mind that the development of the electronic stored program computer relied on the development of electronic memory, we can speculate what this chemical memory might do the same for DNA computers. Knowing something about the structure of the DNA molecule and how it replicates is key to understanding how it can be used in computing.

DNA ROOTS

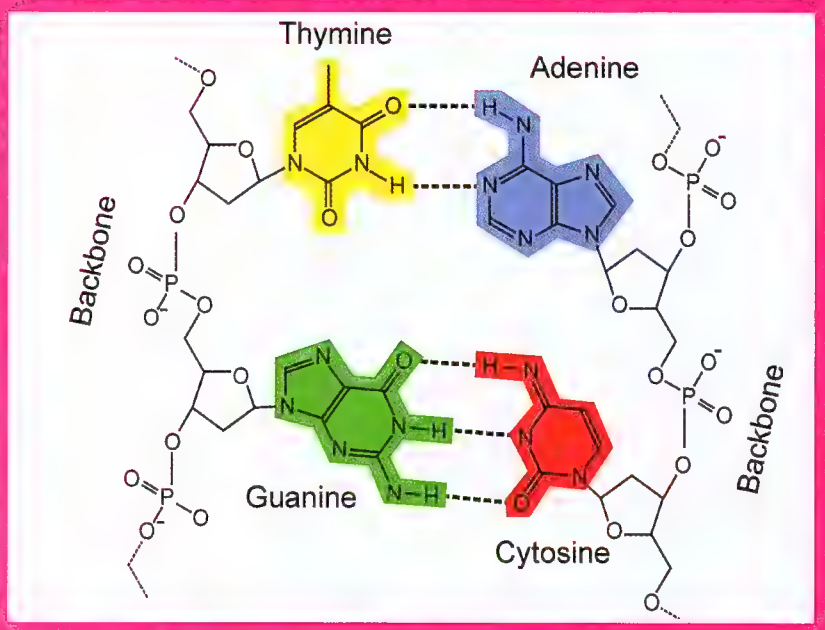
Despite its undeniably futuristic nature, DNA computing can trace its ancestry to a 1994 paper by Leonard Adleman of the University of Southern California. The topic he chose was the Travelling Salesman Problem. The task involves deciding if it is possible for a salesman to visit a list of cities in any order, with fixed start and end locations, passing through each city only once given a list of available direct flights between cities. The normal method of solving the problem is basically a trial-and-error approach but the time taken increases dramatically with the number of cities. Not so with Adleman's computer-in-a-test-tube.

In this pioneering work, just seven cities interconnected by 14 flights were used, but the method has potential to be scaled up. Here, however, we've simplified things further by using just four cities and six flights. The four cities are Atlanta, Boston, Chicago and Detroit, and the available one-way flights are from Atlanta to Boston and Detroit, Boston to Atlanta, Chicago and

QUICK GUIDE

DNA structure

Each strand of the double helix of a DNA molecule is formed of molecular groups called nucleotides. A nucleotide is a combination of three smaller types of molecules: a sugar, one or more phosphate groups and a nitrogenous base. There are four types of bases called Adenine (A), Thymine (T), Guanine (G) and Cytosine (C), and the nucleotides containing these bases can appear in any order along a strand of DNA. While the nucleotides are bonded together with strong chemical bonds in a strand, the bases can also bond to other bases via a weaker so-called hydrogen bond, linking the two strands. These wind around each other to form a double helix. 'A' will only bond with its complementary base 'T', and 'C' will only bond with 'G', so for every 'A' in one strand there is an adjacent 'T' in the other strand. Shown here is a segment of DNA straightened for clarity.



"DNA computing can trace its ancestry to a 1994 paper by Leonard Adleman of the University of Southern California."

Detroit, and Chicago to Detroit. The starting city is Atlanta and the final city is Detroit.

The method involves representing the cities and flights by 8-base DNA strands according to strict rules. The sequence for the DNA strand representing a flight is the complement of the final four bases of the 'from' city, followed by the complement of the first four bases of the 'to' city. The top part of the diagram on the opposite page shows the strands for Atlanta and Boston bonded to the strand for the Atlanta-to-Boston flight, the only flight they will jointly bond with (with the double-strand helix straightened out for clarity).

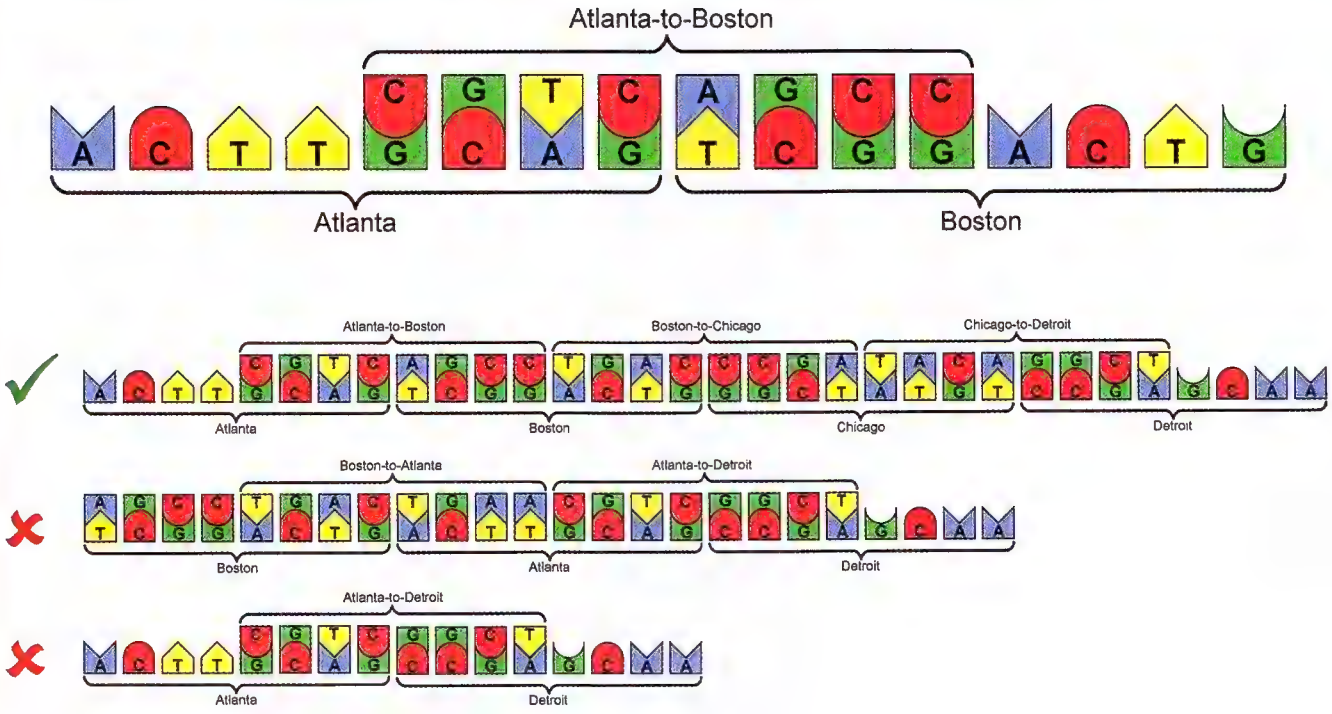
Calculating the solution involves preparing samples of DNA for the cities and flights and mixing a pinch of each together so that chemical reactions can take place. Even such a small amount of each type of DNA contains about a hundred trillion molecules which, almost certainly, would result in all possible combinations of cities and flights being generated by chemical reactions. While all those combinations will be legal in the sense that 'A's would only bond to 'T's and 'C's to 'G's, not all would be valid solutions to the problem. For example, some wouldn't start at Atlanta and end at Detroit and others would miss out a city.

The bottom part of the diagram shows the only valid solution and a couple of invalid ones. Although the correct answer was generated in a few seconds, it was then necessary to isolate it from all the invalid ones. This job took about a week of supplementary chemical reactions, making the whole task much more long-winded than it would have been on a PC, but this was, nevertheless, the birth of a new era of computing. What's more, it served to highlight DNA's potential for massively parallel computation.

DNA LOGIC

Impressive as it might be to have hundreds of trillions of computations take place in a few seconds, Leonard Adleman's historic DNA computing architecture was hard-wired to solve a particular problem. By way of contrast, we've grown accustomed to general-purpose computing hardware that carries out a particular task according to the program stored in its memory. Because the basic building blocks of logic gates are at the heart of general-purpose electronic computers, several researchers have turned their attention to implementing logic gates using DNA.

Most DNA logic gates rely on a chemical reaction known as 'toehold moderated strand displacement'. While reading the following description, we suggest that you refer to the top part of the diagram on page 66. The reaction is between two DNA molecules. One is a single strand and the other a double strand but with the strands offset to leave some single sections, the one coloured light brown being the toehold. Unlike the diagrams in our Quick Guides to DNA structure and DNA replication, we are using colours not to represent



DNA computation has been used to solve the computationally intensive Travelling Salesman Problem using a massively parallel architecture

nucleotides but DNA strands. What's more, colours now represent a unique strand (a unique sequence of nucleotides), while a dark and a light strand of the same colour represent complementary strands. By that we mean strands that have As and Ts interchanged, and Cs and Gs interchanged so that they will bond to form a double strand.

You'll notice that the single DNA strand in part A has the complementary strand to the toehold part of the double strand – the dark brown section – so those two portions of the two molecules will bond together. This gives the single strand a toehold into the double strand, as shown in part B, and this is the start of a fuller reaction. This is shown in part C where the rest of the single strand bonds with the double strand, displacing the original shorter part of the double strand in so doing. We can now build on this basic mechanism to see how this reaction could be used to implement an OR gate, one of the logic gates that form universal electronic computers. This isn't necessarily a practical OR gate and, at the very least, it is a gross over-simplification, but we trust that it provides an inkling of how DNA can be used to implement logic circuitry. In the following description, we are referring to the bottom part of the same diagram.

You'll notice that the single DNA strands are called inputs and outputs, while the double strands are the gates. These are not directly equivalent to logic gates, though; in fact, three such gates are needed to construct a single OR gate. The other thing to point out is that, unlike the case with electronic circuits where 0s and 1s are represented by different voltages, 0s and 1s are represented by the absence or presence of a particular single strand of DNA. In part D we can see the OR gate, comprising three DNA gates; with no inputs, no reactions take place so there is no output. Inputs of 0 and 0, therefore, give an output of 0, which is what would be expected of an OR gate. In part E, we introduce an input and it's clear that this will react with Gate 1 to generate an output. This is what has happened in part F, and we can also see that the output from Gate 1 will react with Gate 3. This has happened in part G, the single strand being the output of the OR gate.

Inputs of 1 and 0, therefore, have generated an output of 1 and, again, this is what is expected of an OR gate. It is fairly clear that a different input (such as anything brown:orange) would react with Gate 2 to produce an output, that would in turn react with Gate 3 to generate the same output – and both inputs together would also generate an output.

The above description raises a couple of questions. First, how is the output from one gate routed to the input of another and, second, why is the green:brown:black strand considered an output of the OR gate as a whole, while the intermediate purple:brown:green strand is not?

In fact, the answers to both questions are related. DNA gates aren't hard-wired to each other as the gates on a silicon chip are. Instead, the gates and the input and output strands are free to move in solution and will do so by diffusion. A single input strand will, therefore, come into contact with lots of gates, but will only react with the ones with a complementary strand.

In our example, therefore, Input 1 could well come into contact with Gate 3, but it won't react since it was designed to react only with Gate 1. In other words, different gates have different input and output strands, even though they all represent a binary 1. This also explains why the presence of the purple:brown:green strand isn't considered to be an output of the complete OR gate. In any practical circuit, the output of the OR gate will be routed to the input of another logic gate, but that logic gate will be designed to respond to the green:brown:black strand and not purple:brown:green.

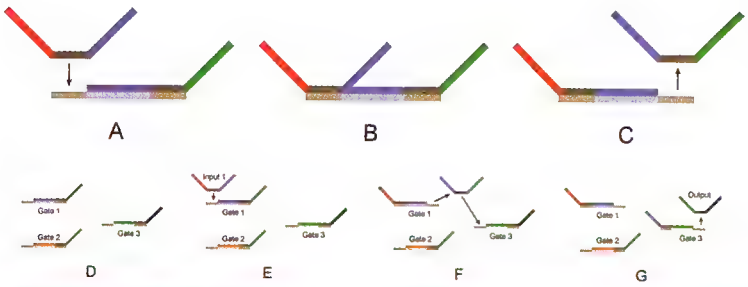
QUICK TIP

Ultra-low power

Supercomputers are hugely power hungry but one based on DNA, like the University of Manchester's proposed machine, could be much more frugal. Researchers say it could perform 2 x 1019 operations per joule – that's a billion times more than an electronic equivalent.

Caltech researchers Erik Winfree and Lulu Qian have already created circuits made from multiple DNA logic gates to perform arithmetic calculations. Their circuit used 130 strands of DNA and was able to calculate the square root of a 4-bit binary number in 6 to 10 hours. More recently, researchers at the University of Washington have used so-called DNA origami to act as scaffolding to anchor the various DNA strands in close proximity to the strands they are designed to react with. This very much reduces the time taken for reacting strands to diffuse towards each other, and has reduced times for simple computations fromhours to minutes.

The fact is, though, that these chemical reactions are never going to come close to reaching the speed of electronic circuits, and fast computation is only going to be achieved by offsetting slow chemical reactions with a massively parallel architecture. Certainly logic circuits can be designed to exhibit parallelism, but massive gains in performance are only going to be realised when there is the scope for inherent parallelism of the type found in Adleman's solution to the travelling salesman problem. On the other hand, as many DNA computing pioneers have pointed out, DNA computation offers major benefits even in cases where speed isn't one of them.



The toehold moderated strand displacement enables logic gates to be constructed from DNA

NON-DETERMINISTIC DNA

So far we've seen an example of a massively parallel DNA computation hard-wired to solve one particular problem. We've also seen the implementation of logic gates in DNA, with the potential for universal computation, but with much less scope for inherent parallelism. Neither seems to take us close to a super-fast, general purpose DNA computer. However, a 2017 project at the University of Manchester holds out the promise of exactly that.

The development was of a so-called non-deterministic architecture and this is the key to the phenomenal performance on offer. We are used to the idea of computers being deterministic, that is, given a particular program instruction and particular data, the action it will take is fixed. In a non-deterministic architecture, however, there is no such direct link between cause and effect. Instead, it is possible to write a program in which instructions provide several alternative courses of action. Until now, such computers were mere thought experiments and, even if they were physically possible, they probably wouldn't give a correct answer to a problem because they might guess the wrong course of action from the alternatives provided in the program. The University of Manchester's novel DNA-based architecture changes all that.

The university's Professor Ross King likes to give the example of solving a maze to show how this might work. Each time a junction is reached, rather than following one of the two paths at a time as a conventional program would, the code specifies that either path could be taken, and the inherently parallel nature of the architecture enables both to be taken simultaneously. Once these two paths reach further junctions, the computer would find itself following four paths concurrently, and so on, with the number of parallel paths increasing exponentially. Formerly a pipe dream, DNA makes this feasible, as King explained. "To achieve this we utilise DNA's ability to replicate. At any choice point in a computation, our NUTM (Non-deterministic Universal Turing Machine) replicates itself and takes all possible choices."

This DNA research uses Thue strings, which offer a quite different model of computation to the one we're familiar with, as Professor King elaborates. "The Thue string model is a rewriting system. For example, if you see the string 'ac' you can rewrite it as 'ca', and vice-versa. The non-determinism comes from the fact that there may be multiple choices of possible rewrites in a string".

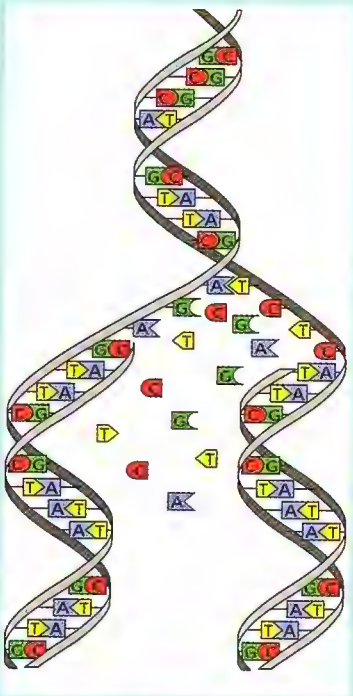
Unfortunately, it appears that programming it is by no means a trivial task. "We know from the theory of computer science that the Thue system is universal – that is, it can be used to compute anything any other computer can do. However, that does not mean that programming it is easy; it is even more difficult than a classical Turing

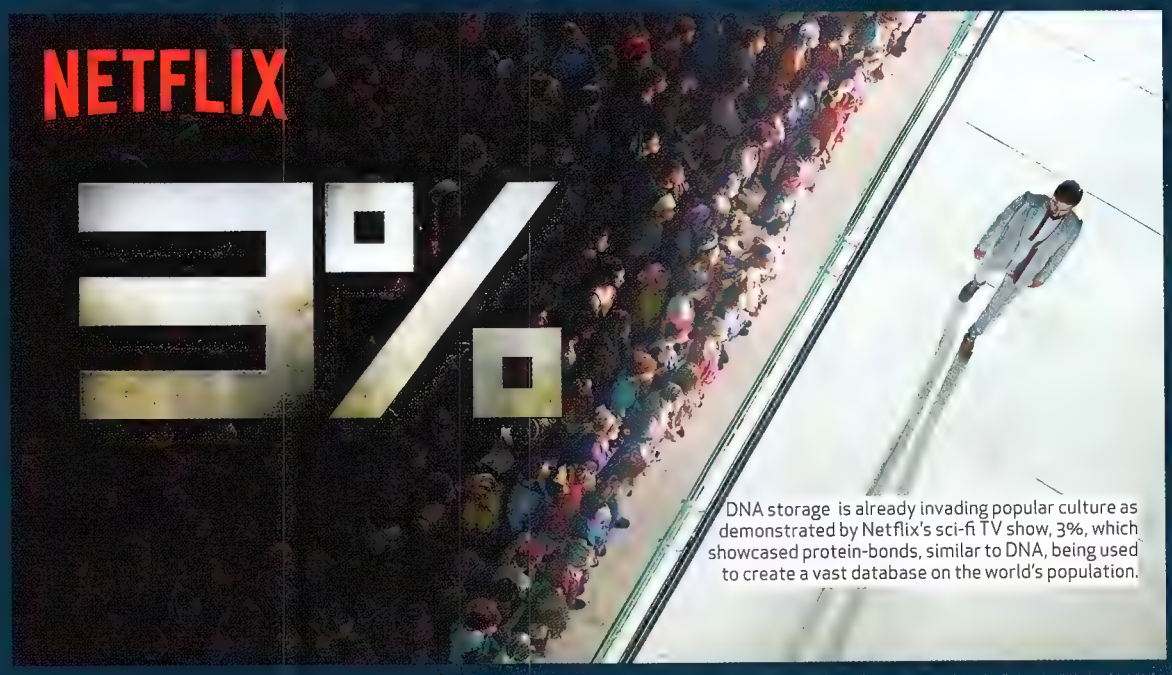
QUICK GUIDE

DNA replication

DNA replicates itself in cell division via the polymerase chain reaction, which is also key to some DNA-computing architectures. Replication starts with the double helix unzipping itself by breaking the hydrogen bonds that keep the two strands together. As the two strands start to separate, the now un-bonded bases are free to bond to bases in other nucleotides.

So long as there are free nucleotides around, this is exactly what happens, but only nucleotides with the complementary bases can create new hydrogen bonds. So As and Ts attract each other, as do Cs and Gs and, in so doing, both strands of the original DNA bond to the nucleotides necessary to replace the missing complementary strand. In time, this process produces two DNA molecules identical to the original one.





DNA storage is already invading popular culture as demonstrated by Netflix's sci-fi TV show, 3%, which showcased protein-bonds, similar to DNA, being used to create a vast database on the world's population.

Machine. Indeed, neither I nor my colleagues have coded anything significant. It would be an interesting challenge to your readers to emulate the Thue system and to use it to, say, encode the addition of two numbers".

So what of the future for NUTMs? Will we ever see them on the desktop? The fact is that DNA reactions will never be fast, but this can be more than offset by the massive parallelism on offer. So, for general purpose computing, with minimal scope for high levels of parallelism, simple problems would actually take longer.

In the elite world of high-performance computing, though, things couldn't be more different. We could envisage a scenario in which DNA-based NUTM co-processors work alongside conventional silicon processors in supercomputers to achieve a massive increase in performance and, at the same time, a huge reduction in energy consumption.

DNA STORAGE

While DNA computers are likely to be niche products, there is evidence that DNA as a storage media may soon be much more mainstream. In nature, the sequence of nucleotides in each strand of DNA represents the data that describes the very nature of the species and the traits of the individual. But outside a living being, the sequence of DNA could, in theory, represent anything. If we bear in mind that there are four different bases, each base could potentially represent two bits of information.

Things aren't quite that simple because DNA reactions aren't 100% repeatable and this would lead to corrupted data; they are slow, so reading and writing would take place at a snail's pace; and currently costs would be astronomical. But methods have been devised to counter the effects of data loss by using redundancy; prices will certainly reduce if and when the technology is commercialised, and a slow access speed isn't a problem for its intended application. That application is data archiving, and here the benefits of DNA are its longevity and data density. When we recall that DNA testing was a key element in identifying the 'skeleton in a car park' as the remains of Richard III a few years ago, the fact that DNA can survive for hundreds of years, even in non-ideal conditions, is evident. In fact, DNA has been extracted and sequenced from Egyptian mummies and from extinct animals such as mammoths and sabre-toothed cats, which makes the 10-100 year lifetime of optical discs, magnetic storage and flash memory look rather puny by comparison.

Meanwhile, data density is absolutely staggering. Researchers at Microsoft and the University of Washington have encoded 215 petabytes (215,000 terabytes) into a gram of DNA; at this density, all the world's data could be stored in 10 tonnes of DNA, which could fit into a trailer. By way of comparison, it's been estimated that the same data on a stack of CDs would reach beyond the moon.

Doug Carmean of Microsoft Research is widely reported as saying that they aim to have a "proto-commercial system in three years storing some amount of data on DNA in one of our data centres, for at least a boutique application". Indeed, speculation is rife that Microsoft plans to add DNA storage to its cloud-based services in the not-too-distant future.

So will we shortly have DNA in our desktop PCs for day-to-day work? Probably not, thanks to the speed deficit, but the molecule of life might soon be immortalising our cherished photos and irreplaceable data instead. And let's face it, if we ever do have DNA processors injected into our bloodstream, that will surely be the ultimate in personal computing. ■

QUICK TIP

Time vs. mass

DNA technology could reduce processing time overheads, but at a different sort of cost. Tiny as DNA molecules are, repeatedly doubling their number, as is required for some tasks, means you'd eventually need more DNA than the mass of the earth.

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

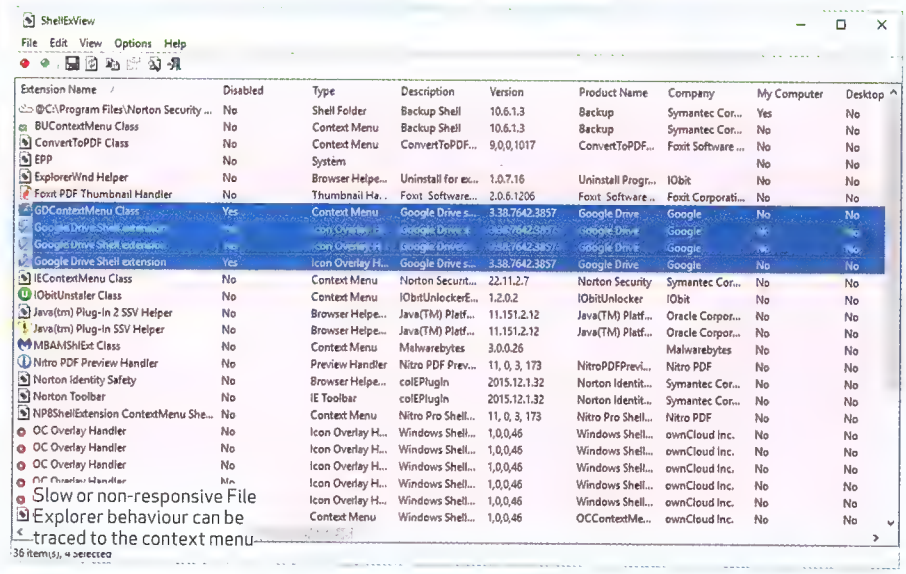
WINDOWS

FILE EXPLORER SLUGGISH

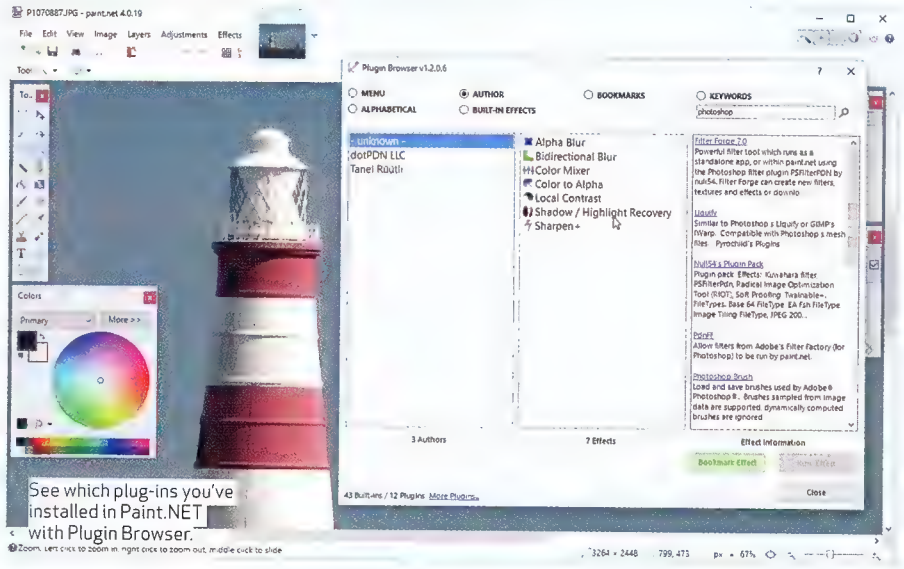
When I right-click inside a File Explorer window, it takes around 20-30 seconds to react. Sometimes File Explorer will even crash and then restart. What's causing this slowdown?
Dorothy Anders

The likely culprit is a third-party program that's installed features to the File Explorer context menu. The simplest way to view and manage these is with Nirsoft's ShellExView (**www.nirsoft.net/utils/shexview.html**). Download, install and launch the program. Choose Options > Hide All Microsoft Extensions to filter out everything except third-party extensions. Start by pressing Ctrl-A to select them all, then press F7 to disable them. Right-click the Taskbar and choose Task Manager. Highlight File Explorer and click Restart.

If – as Dorothy discovered – things immediately improve, you'll know one of these items is to blame. Re-enable them in batches – when the problem resurfaces, you'll be able to focus your troubleshooting on the last set of extensions you re-enabled. In this case, we traced the problem to the Google Drive shell extension. This is a known issue which, hopefully, Google will soon issue a fix for.
Mayank Sharma



Slow or non-responsive File Explorer behaviour can be traced to the context menu



See which plug-ins you've installed in Paint.NET with Plugin Browser.

SECURITY

STUBBORN PUP JUST WON'T GO AWAY

When I run a scan with AdwCleaner it always comes up with the following: 'Chromium Extension Advance SystemCare Surfing Protection'. I don't know where it is, and it keeps coming back. Should I just ignore it?
Jim Duncan

You could safely ignore this – it's linked to IObit software, which is safe enough – but Jim had no memory of having installed Advanced SystemCare, while Firefox was the only web browser installed on his PC. We kept digging and confirmed it was linked to the Chrome web browser, which Jim eventually remembered having briefly installed, suggesting there are some leftovers on his PC's hard drive somewhere. We discovered where the leftovers are likely to be: press Windows-R to open the Run dialogue box, type `%LocalAppData%` and press Enter to access the hidden AppData\Local folder in your personal user folder. From here open a Google folder and see if there's a Chrome folder inside – deleting this should clear the leftover files.
Rob Mead-Green

APPLICATIONS

BROWSE PLUGINS FOR PAINT.NET

I've recently discovered that Paint.NET supports plugins. I've installed loads, but have lost track of what I've installed. Is there any way I can keep track of them?
Frank Farrell

The best tool for the job is the Plugin Browser, which lists all plugins – including the 43 bundled with the program itself – that have been installed. It's simple to install: visit

forums.getpaint.net and navigate to 'Plugins – Publishing ONLY' and you'll find it pinned to the top of the list. Save the .zip file to your Downloads folder, then extract and run the .exe file inside – ignore the SmartScreen warning, it's safe to install.

Once you've installed Plugin Browser, click Close, open Paint.NET and access it via Effects > Plugin Browser where you can browse by various criteria. You'll also see a keyword search tool: this can be used to search the plugin index online to track down more plugins – just click a hyperlink to be taken to the relevant web page. Plugins are downloaded as .zip files, then if no installer is provided, you copy the .dll file inside the .zip archive to the relevant subfolder – typically Effects – inside C:\Program Files\Paint.NET.

Nate Nate Drake

WINDOWS

UPDATE WINDOWS 7 INSTALLATION DISC

I'm unable to perform a repair install of Windows 7 because it says my installed version is newer than the version that's on the disc. How do I go about getting an updated version?

Deborah Yardley

You need install media that has both Windows 7 and Service Pack 1 slipstreamed into it. Here's how you can get your copy, courtesy of Microsoft. Open File Explorer: right-click Computer in the left-hand pane and choose Properties to open the System Control Panel. Make a note of your Windows system type (32-bit or 64-bit) in the System section. Open your web browser and go to **www.microsoft.com/software-download/windows7** and enter your product key to obtain the correct edition. When prompted, select 32-bit or 64-bit depending on your system type to download the file. Once downloaded, insert a blank DVD into your disc rewriter, then locate the ISO file and double-click it. Your burner should be detected, so tick 'Verify disc after burning' and click Burn, then sit back and wait for the install disc to be created. Download and run Rufus Portable from **rufus.akeo.ie**. Click the FreeDOS drodown menu and choose ISO Image, then click the disc icon to select your ISO file. Select your USB drive from the Device drop-down menu and click Start.

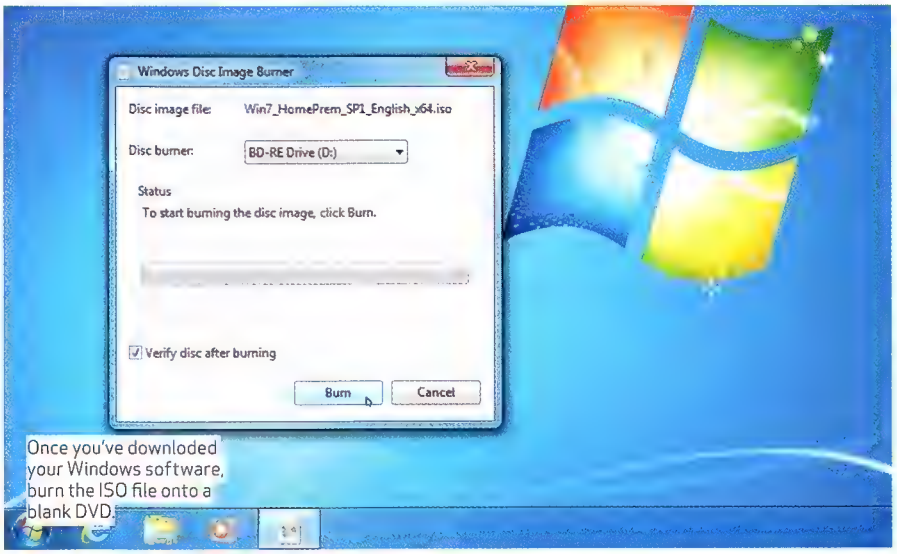
Rob Mead-Green

SECURITY

STOPPING SPECTRE AND MELTDOWN IN THEIR TRACKS

I'm a little rattled by the ongoing revelations about processor (in)securities. I have a four-year-old PC with an Intel Core i5-4450 (Haswell) chip. What steps can I take to protect myself against the Spectre and Meltdown vulnerabilities?

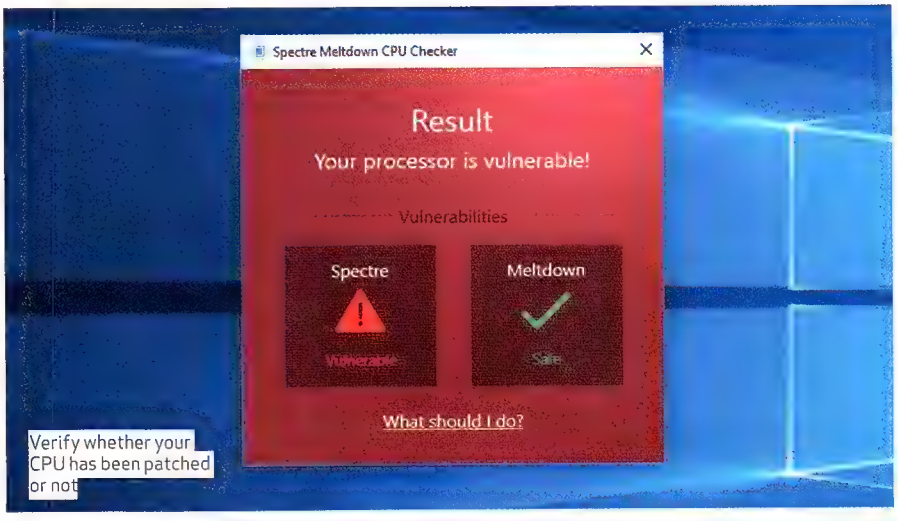
Frank Eldon



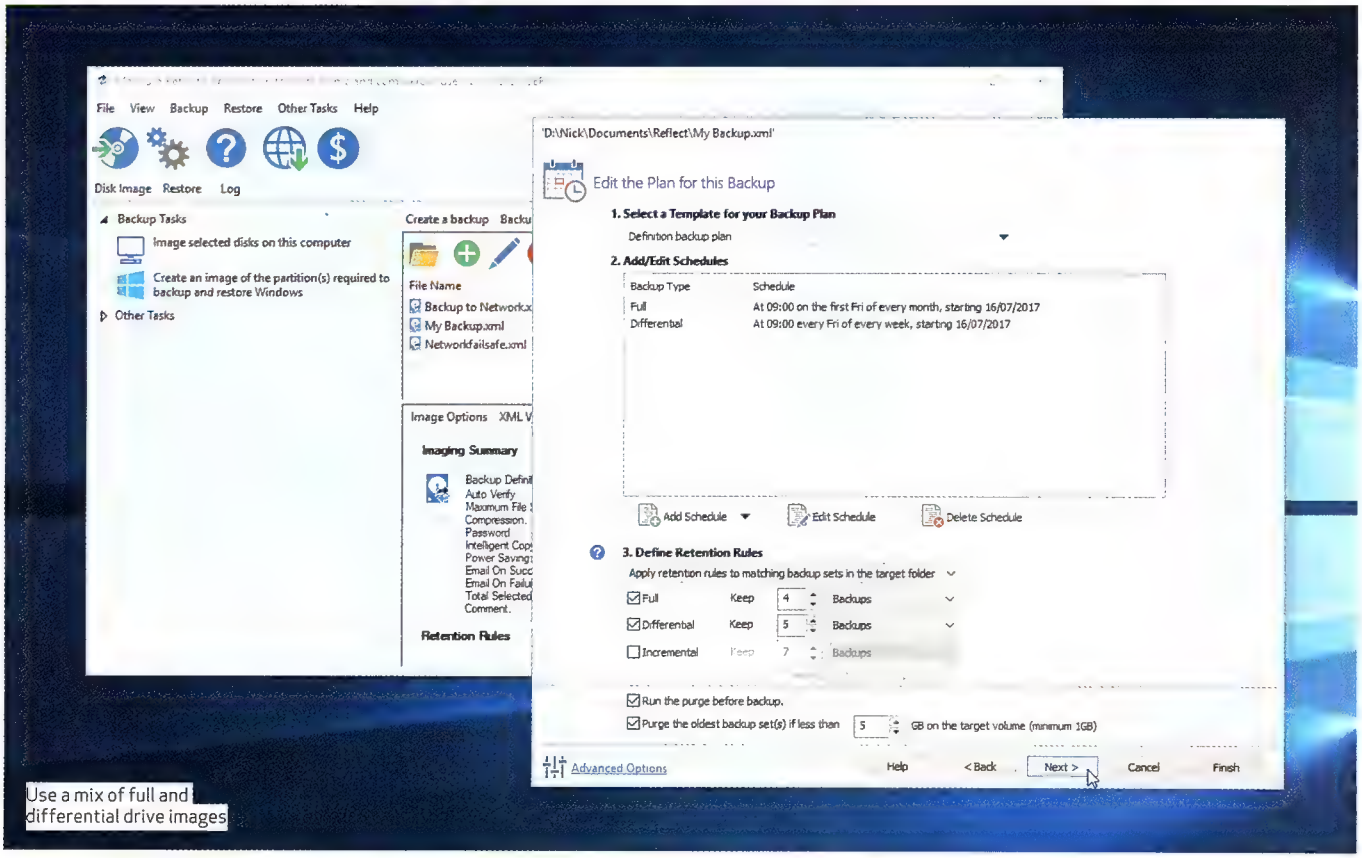
Once you've downloaded your Windows software, burn the ISO file onto a blank DVD.

> "I'm unable to perform a repair install of Windows 7 because it says my installed version is newer than the version that's on the disc."

We'll assume that you know what these vulnerabilities are – flaws so fundamental that virtually every PC out there is affected by at least one vulnerability. Start by verifying that your chip is affected by one or both vulnerabilities with the help of Ashampoo's free Spectre Meltdown CPU Checker (**bit.ly/ashamspectre**). Once confirmed, make sure your web browsers are fully updated to close the door on one type of Spectre-based attack. Also check that Windows has also been patched against both threats – Windows 7, 8 and 10 should have received fixes in January. If you've not received any updates since the turn of the year, your anti-virus will need updating to let Windows know it's compatible (and stop it blocking updates). Contact your anti-virus vendor if this doesn't happen – if necessary, you'll need to switch to another security program. Intel chips will also need a microcode patch. The older your processor, the longer you'll have to wait and see if Intel will provide one. Intel has released a patch for the Haswell chip in Frank's PC. Nevertheless, there's one more hurdle to overcome: Intel isn't deploying the patch. Instead, you're relying on your system or motherboard manufacturer to provide this as part of a BIOS firmware update. Frank's motherboard



Verify whether your CPU has been patched or not


File View Backup Restore Other Tasks Help
Disk Image Restore Log
Backup Tasks
Image selected disks on this computer
Create an image of the partition(s) required to backup and restore Windows
Other Tasks
Create a backup
File Name
Backup to Network
My Backup.xml
Networkfailsafe.xml
Image Options
Imaging Summary
Retention Rules
'D:\Nick\Documents\Reflect\My Backup.xml'
Edit the Plan for this Backup
1. Select a Template for your Backup Plan
Definition backup plan
2. Add/Edit Schedules
Backup Type
Schedule
Full
At 09:00 on the first Fri of every month, starting 16/07/2017
Differential
At 09:00 every Fri of every week, starting 16/07/2017
Add Schedule
Edit Schedule
Delete Schedule
3. Define Retention Rules
Apply retention rules to matching backup sets in the target folder
Full Keep 4 Backups
Differential Keep 5 Backups
Incremental Keep 7 Backups
Run the purge before backup.
Purge the oldest backup set(s) if less than 5 GB on the target volume (minimum 1GB)
Advanced Options
Help
< Back
Next >
Cancel
Finish
Use a mix of full and differential drive images

"I switched on my Windows 10 laptop and was told it needed the latest security updates, but that Microsoft had to first install the latest version of Windows 10."

manufacturer – ASRock – hadn't deployed any updates for older motherboards at time of writing, but keep checking back (and keep an eye on official user forums too) for updates.
Rob Mead-Green

BACKUP
WHAT BACKUP PLAN DO I NEED?

I notice that you're big fans of Macrium Reflect Free. Can you explain why is this a better backup tool than the drive imaging option offered by the Windows 7 Backup and Restore tool?
Graham Ellesmere

There are numerous reasons why we love Macrium Reflect Free – which, as a reminder, is available for download at **www.macrium.com/reflectfree.aspx**.

Its main advantages over Windows' built-in drive-imaging tool include being able to verify that your drive images aren't corrupt, and you can also easily extract individual files from the image. Macrium Reflect Free also enables you to take advantage of differential backups, which take up significantly less size than a full backup, allowing you to store multiple snapshots of your system at different points in time without gobbling up too much storage space.

Our recommended approach when using the app is to create two separate backup jobs, with each pointing to a different backup device (say an external storage drive and a network drive). Each backup job should run at different times during the week, and you should set up a schedule that takes one full backup a month, supplemented by weekly differential backups.
Matt Hanson

WINDOWS
WINDOWS 10 SECURITY UPDATE

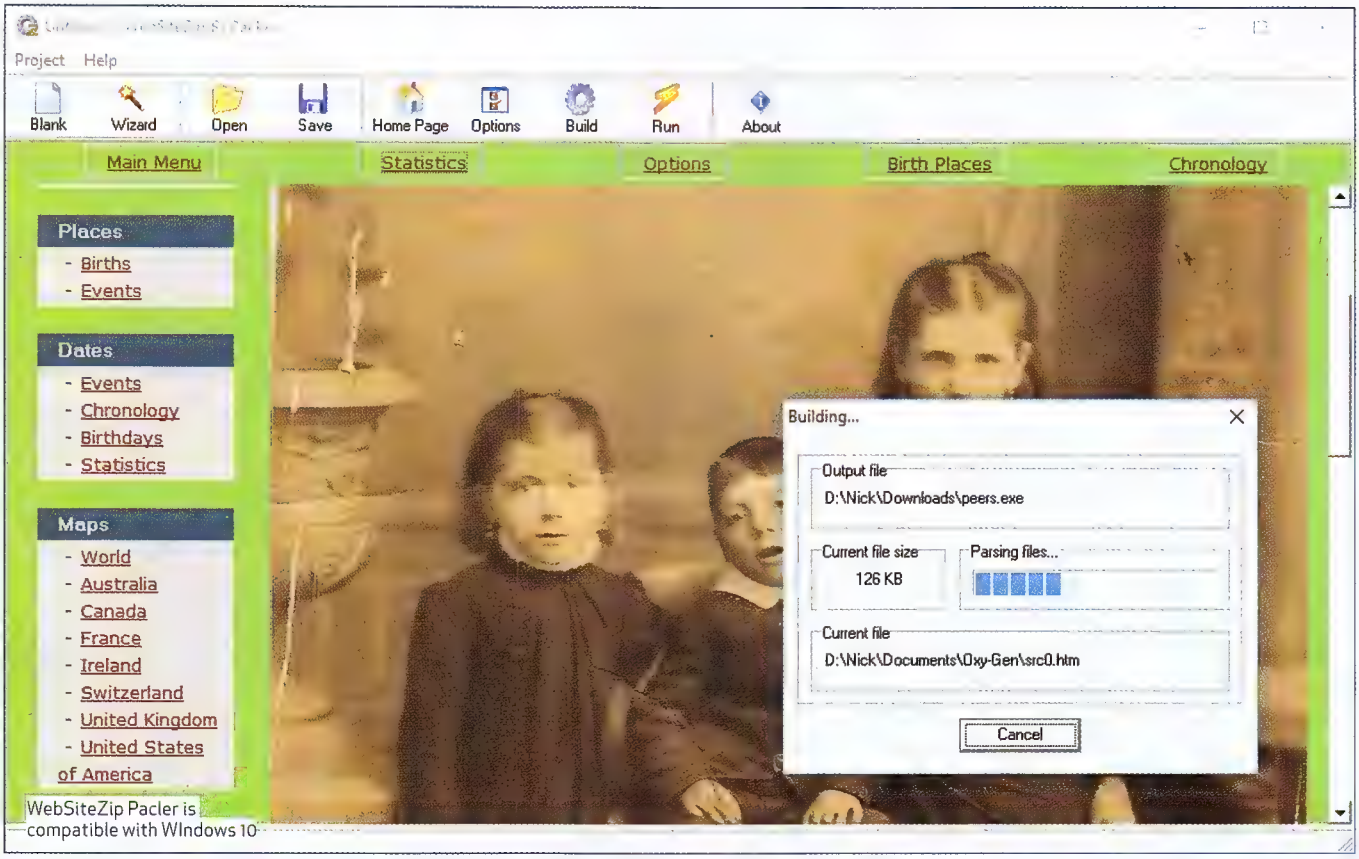
I switched on my Windows 10 laptop and was told it needed the latest security updates, but that Microsoft had to first install the latest version of Windows 10. After 24 hours it's stuck at 99%. What should I do?
Andrew Winton

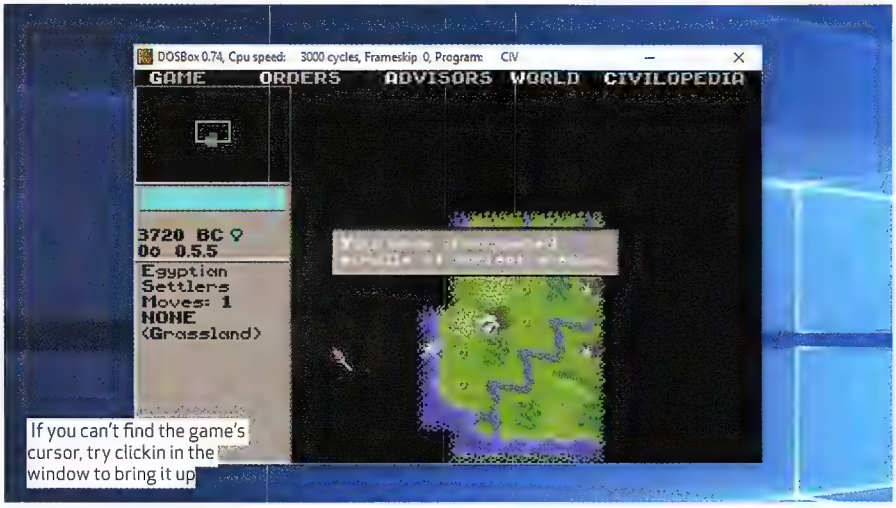
The warning about not switching off or closing your PC can be safely ignored by this point – although check the hard drive activity light isn't flashing before you do exactly that. With his heart in his mouth, Andrew switched off his laptop, then powered it back on. It immediately began to update again, and by midnight his lengthy Windows 10 update had completed successfully.
Rob Mead-Green

APPLICATIONS
COMPATIBILITY ISSUE WITH HYPERMAKER

I produce interactive web-based files for a local museum. Once prepared, I use HyperMaker to compile the files into a single .exe file that can be run on any PC, but the program no longer works in any version of Windows where Internet Explorer 11 has been installed. Can you help me overcome this incompatibility?
Ed Cumming

Given that HyperMaker no longer works with IE11, it's time to retire it. We've found a similar free alternative called WebSiteZip Packer (**www.spadixbd.com/wsz/**), which installed and ran with no problems on our Windows 10 machine. Ed has managed to keep HyperMaker going on an old netbook, but we've recommended he experiment with WebSiteZip Packer going forward to see if it's a suitable replacement – the .exe files it produces work flawlessly in Windows 10, making it a viable alternative to HyperMaker.
Cat Ellis




DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: CIV
GAME ORDERS ADVISORS WORLD CIVILOPEDIA
3720 BC
0o 0.5.5
Egyption
Settlers
Moves: 1
NONE
(Grassland)
If you can't find the game's cursor, try clickin in the window to bring it up

GAMING

PLAY OLD DOS GAMES IN WINDOWS

I recently stumbled on a copy of the original Civilization game, which I used to play back in the day. Is there an easy way to play this in Windows 10?
Graeme Lyle

The simplest thing to do is use a free app called DOSBox (**www.dosbox.com**). It simulates the MS-DOS environment and works with classic PC games which were written in DOS. Download the Win32 installer (which works on both 32-bit and 64-bit systems), double-click it and follow the prompts, installing the program to its own folder on the root of drive C. This should install the program with no compatibility problems. Open File Explorer and browse to the root of drive C, then create a folder called 'oldgames'. Copy the contents of the game CD to a folder inside it called 'CIV1' – alternatively, download and extract a zipped copy from **www.abandonia.com**. Type `dosbox` into the Search bar and click DOSBox to launch it. Type `MOUNT C C:\OLDGAMES` into the window that appears and press Enter. When drive C is confirmed as mounted to the 'oldgames' directory, type `C:` and hit Enter. Type `CD CIV1` , press Enter, type `CIV` and Enter to launch the game. Press 1 , 4 and 2 respectively to set graphics, sound and control modes. When the game starts, click inside the window to capture the mouse. Exit by pressing the Windows key.
Mayank Sharma

EMAIL

OUTLOOK WON'T SEND TO A SPECIFIC ADDRESS

Our church organist has developed a problem: he can't send emails to one of my email addresses from his laptop. He can send them to everyone else – including another of my email addresses and to my wife on the same domain name – but not this specific address. We've checked Outlook is set up correctly and there are no rules or blacklists. When I check his Sent folder, it shows the email address as being '0' along with the subject, but no email appears to have been sent.
Ian Henderson

We traced the problem to the organist's Contacts folder which had Ian's non-functioning email address.
The solution is to open this contact information card, delete the name below the email address and press Tab, which will show the correct name and email address in parenthesis. Save and close the contact. Now create a new email. Start typing the name as shown in the contact information card – when it appears in the autofill field, highlight it and hit Delete. This removes the name from the autofill list but not the contact. Now click 'To:' and locate your contact – the correct name and email address should then appear.
Alex Cox

72
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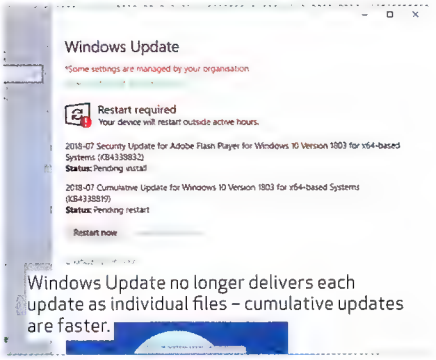
Take back control of Windows updates

Find out how Windows Update works, plus learn how to take back control of the update process and fix update-related problems.


Windows Update
*Some settings are managed by your organisation
Restart required
Your device will restart outside active hours.
2018-07 Security Update for Adobe Flash Player for Windows 10 Version 1803 for x64-based Systems (KB4338832)
Status: Pending install
2018-07 Cumulative Update for Windows 10 Version 1803 for x64-based Systems (KB4338819)
Status: Pending restart
Restart now
Windows Update no longer delivers each update as individual files – cumulative updates are faster.

Struggling to understand how Windows Update works? Frustrated because it's not working the way it should? Then you've come to the right place. In this feature we're going to take you on a complete tour of Windows Update in Windows 7, 8.1 and 10.

We open with a close look at what Windows Update does and – critically – how it works. You'll discover the different types of update it provides, and how it packages them up and delivers them to your PC. If you're running Windows 10 you may be in for a shock, but we reveal how to take back control of how updates are delivered from Microsoft.

Speaking of taking back control, we'll also reveal how to manually stop Windows Update from forcing updates down your throat if you're running Windows 10 Home Edition, and take an in-depth look at how to update and control the process if you're running Windows 10 Pro, or an earlier version of Windows.

Last, but by no means least, we'll take a look at troubleshooting those pesky Windows Update problems you're almost certain to run into. You'll find out how to fix most problems using a combination of Windows and third-party tools, track down solutions to stubborn updates refusing to install and even take steps to get your PC working again should an update render your PC unbootable. Enough talk, let's start taking control.

HOW UPDATE WORKS

Let's start by discovering exactly what Windows Update does – and how it works

The clue is in the name: Windows Update is designed to keep your copy of Windows up to date through the delivery of special files that patch Windows in various ways. The most obvious updates are security hotfixes, which patch vulnerabilities and security holes in the operating system that could be exploited by malware, as well as bug fixes that aim to resolve specific issues.

Windows Update also delivers bigger updates, too – what once were Service Packs and then point releases (Windows 8.1) have now evolved into feature updates, delivered bi-annually to add new features and change the way existing features work in Windows 10. The latest feature update is the April 2018 Update (version number 1803), set to be superceded in spring by the as-yet-untitled 1809 update.

Microsoft also provides what are known as 'optional' updates, which include other Microsoft tools, such as the .NET Framework, as well as signed hardware drivers, which have been rigorously tested and verified to work well with Windows. Some updates are 'recommended' and so sit alongside important updates by default. All optional and recommended updates can be clearly found in the Windows Update tool in Windows 7 and 8.1, but they're hidden from view in Windows 10. We'll show you how to find, review and install optional updates easily on pages 74-75.

Windows Update can also be extended to include updates for other Microsoft products – such as Microsoft Office, or software for controlling Microsoft keyboards and mice.

HOW UPDATES ARE PACKAGED

These days, updates are packaged up and delivered to reduce their size and number, based on what's already installed on your PC.

A 'Full' update contains all the updates released since the last major version of Windows (such as Windows 8.1 or the Windows 10 April 2018 Update). This is typically required after you've just installed or reinstalled the latest version of Windows.

'Delta' and 'Express' updates work in a similar way – so much so that Microsoft will be retiring Delta updates as of February 2019, so we'll focus on Express. Express updates are differential – they're generated on demand after Windows Update examines your PC's current state to contain only those updates not yet installed. This means they're smaller files, and so are faster to download and install.

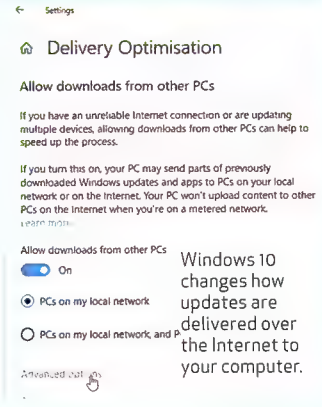
Since 2016, Windows 7, 8.1 and 10 have received updates on a monthly basis – 'Patch Tuesday'. These consist of a single, cumulative or 'rollup' update that contains all security and bug fixes developed over the past month along with any updates missing from your PC from previous months.

What's Delivery Optimisation?

Windows 10 users need to be aware of a feature known as Delivery Optimisation, which affects how Microsoft delivers updates to PCs over the web. Head to 'Settings > Windows Update > Advanced options' and click the Delivery Optimisation link. Here you'll see a setting called 'Allow downloads from other PCs', which basically means when the feature is switched on (as it is by default), it's possible to receive Windows updates using peer-to-peer technology from files stored on other PCs across your network and the internet. In turn, these files can also be sent from your PC to other computers, too.

Click 'Activity monitor' to review how much data is being transferred and how much bandwidth is being used, then click 'Advanced options' to set manual limits that should help prevent your connection from being overwhelmed.

Better still, switch the feature off completely if you're the only PC user in your home. If not, change the setting to 'PCs on my local network' so you can speed up deploying updates to other PCs without having to open them up to the wider web.


Settings
Delivery Optimisation
Allow downloads from other PCs
If you have an unreliable Internet connection or are updating multiple devices, allowing downloads from other PCs can help to speed up the process.
If you turn this on, your PC may send parts of previously downloaded Windows updates and apps to PCs on your local network or on the Internet. Your PC won't upload content to other PCs on the Internet when you're on a metered network.
Learn more
Allow downloads from other PCs
On
PCs on my local network
PCs on my local network, and P
Advanced options
Windows 10 changes how updates are delivered over the Internet to your computer.

Make Windows Update behave itself

Discover how to use Windows Update, and wrest back control of the update process from Windows 10.

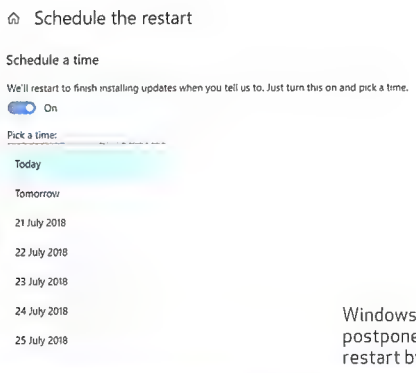
Updating Windows is an incredibly important part of your day-to-day maintenance, but many people put off the updating experience if they can. This isn't laziness – Microsoft has quite the reputation for releasing patches before they're ready for general consumption, and there are horror stories of Windows installations falling over.

Despite this, in most circumstances it pays to ensure you're at least up to date with the latest security hotfixes, so opting out of updates altogether – even where possible – isn't practical. Let's see what you can do about ensuring the Windows Update process works with you and not against you.

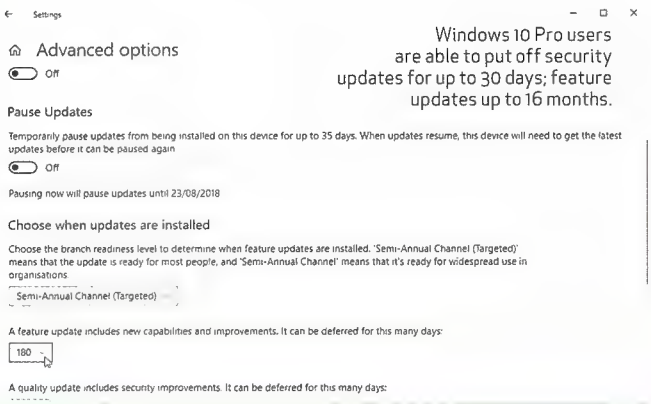
TAKE BACK CONTROL

When Microsoft released Windows 10, it took control away from the end user running Windows 10 Home, and now forces updates to be installed as soon as they are available and downloaded. At this point, Windows will tell you that updates are pending and prompt you to restart your PC.

It's configured to force a reboot to install updates outside your 'active hours', in other words, when you're not typically using your PC – which is 5pm–8am by default (click 'Change active hours' from the main Windows Update settings screen to change them). It means you can't delay an update indefinitely simply by refusing to shut down or restart, but you can defer it slightly: click 'Schedule the restart' next to the 'Restart now' button, flick



Windows 10 Home users can postpone the inevitable forced restart by up to seven days only.


Settings
Advanced options
Off
Pause Updates
Temporarily pause updates from being installed on this device for up to 35 days. When updates resume, this device will need to get the latest updates before it can be paused again
Off
Pausing now will pause updates until 23/08/2018
Choose when updates are installed
Choose the branch readiness level to determine when feature updates are installed. 'Semi-Annual Channel (Targeted)' means that the update is ready for most people, and 'Semi-Annual Channel' means that it's ready for widespread use in organisations
Semi-Annual Channel (Targeted)
A feature update includes new capabilities and improvements. It can be deferred for this many days:
180
A quality update includes security improvements. It can be deferred for this many days:

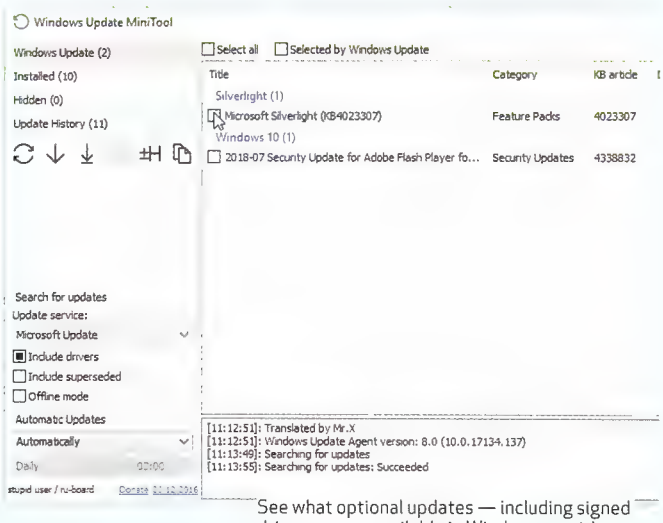
Windows 10 Pro users are able to put off security updates for up to 30 days; feature updates up to 16 months.

Optional updates

Windows Update provides 'optional' updates that include additional components such as Microsoft Silverlight. They also include Microsoft-delivered drivers for a wide range of hardware. Windows 7 and 8.1 users can review and install these via Windows Update as shown in the main text, but these updates are hidden from view in Windows 10 — installing driver updates is a hit-and-miss affair involving going into Device Manager and clicking Update Driver from the Driver tab of selected devices.

To see what's available, and install them directly, download the Windows Update MiniTool (**bit.ly/2v9BwtK**). Extract its contents and then run wumt_x64.exe (64-bit) or wumt_x86.exe (32-bit) depending on your Windows system type. Click the 'Check for updates' button under Update History after verifying 'Include drivers' is selected. From here you can select the updates you want and click the 'Install Updates' button to install them.

It's also possible to hide unwanted updates here — if you're struggling with an update that repeatedly refuses to install, hiding it will stop Windows attempting to install it time and time again.



See what optional updates — including signed drivers — are available in Windows 10 with the Windows Update MiniTool.

the switch to On and you can choose to push back the restart by up to seven days. It's fine as a last resort, but can you really go for seven days without needing to restart or shut down your PC?

You'll have an easier time if you use Windows 10 Pro: Head over to 'Settings > Update & Security > Windows Update' and click Advanced Options. You'll find a Pause Updates switch, which allows you to pause updates for up to 35 days — handy if you hear of an update causing problems and want to put things off.

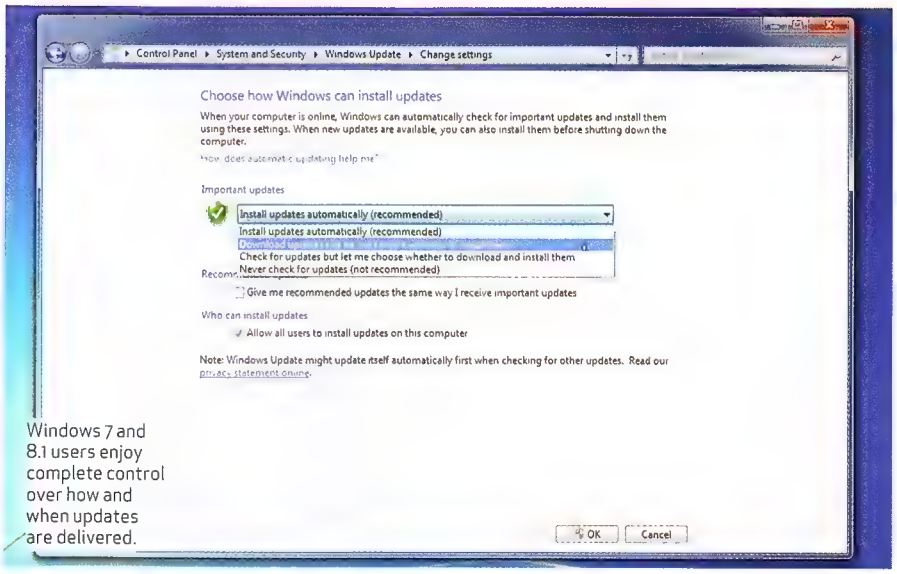
A better way to prevent updates from getting on your system before they're ready is to scroll down to 'Choose when updates are installed'. You can delay feature updates by around four months after their release by switching from the Semi-Annual (Targeted) channel to Semi-Annual via the drop-down menu. You can defer this for up to an additional year (or 365 days) via the Feature Update Defer drop-down menu. It's also possible to defer quality updates — patches and security hotfixes — for up to 30 days via another drop-down menu. That way you can avoid exposing your PC to an update that's later pulled for stability reasons.

What if you're running Windows 10 Home? The step-by-step guide below reveals a technique for manually disabling Windows Update that works for the latest April 2018 Update. Note, you should still periodically check for updates — launch the tool and re-enable the service to do so, then disable it again after use.

WINDOWS 7 AND 8.1

If you're still using Windows 7 or 8.1, then you remain in full control of the process. Open 'Control Panel > Windows Update' where you'll see a screen telling you how many updates are waiting to be installed. Click 'Check for updates' to refresh this search at any time. Updates are divided into two types: important and optional. You'll be shown how many of each are available — click the relevant hyperlink to view and select which ones to install using the tick boxes. For more information about a specific update, select it for a summary, then click 'More information' for a full description online.

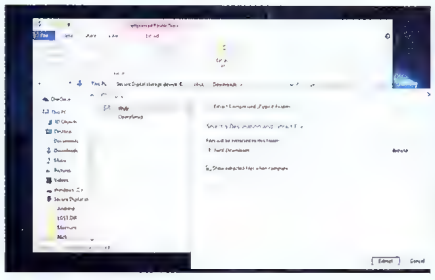
You'll also see a status about whether the update has been downloaded or not, and whether it's ready to be installed on your PC. This status ties into how you've configured Window Update. Click OK to return to the main screen, then click 'Change settings' to control when and what updates are deployed to your computer.


Control Panel ▸ System and Security ▸ Windows Update ▸ Change settings
Choose how Windows can install updates
When your computer is online, Windows can automatically check for important updates and install them using these settings. When new updates are available, you can also install them before shutting down the computer.
Important updates
Install updates automatically (recommended)
Install updates automatically (recommended)
Check for updates but let me choose whether to download and install them
Never check for updates (not recommended)
Give me recommended updates the same way I receive important updates
Who can install updates
Allow all users to install updates on this computer
Note: Windows Update might update itself automatically first when checking for other updates. Read our
OK
Cancel
Windows 7 and 8.1 users enjoy complete control over how and when updates are delivered.

By default, updates are installed automatically either at a set time or when you next reboot, but if you want to pause before installing them we recommend choosing 'Download updates but let me choose whether to install them'. You can also review available updates before downloading them or switch the feature off entirely. We don't recommended doing this, however, since both Windows 7 and 8.1 are still supported by security hotfixes, and so should be kept up to date.

You'll also see a box allowing you to opt out of automatically receiving 'recommended' updates alongside critical ones. Unticking this box basically means recommended updates like the .NET Framework Tool are moved to the Optional category, where they'll be italicised to make them stand out (see the 'Optional updates' boxout opposite).

Switch off Windows Update

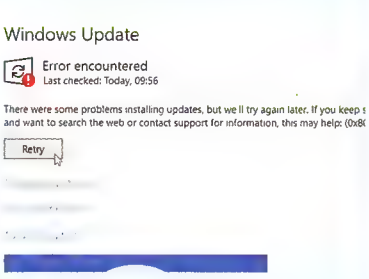


1 DOWNLOAD AND RUN

Download the Windows Update Blocker tool from **www.sordum.org/9470/** — the grey Download button is just above the 'Related Posts' section. Once it's downloaded, right-click Wub.zip and choose 'Extract All'. Next, double-click Wub.exe inside the extracted folder to launch the program.

2 SWITCH OFF SERVICE

A small window will appear. Select 'Disable Service' and verify that 'Protect Service Settings' is ticked. Click 'Apply Now' and the status should change to a red shield with an X indicating it's been disabled. Reboot your PC — note that any updates already awaiting a reboot will still be installed.



3 CHECK FOR UPDATES

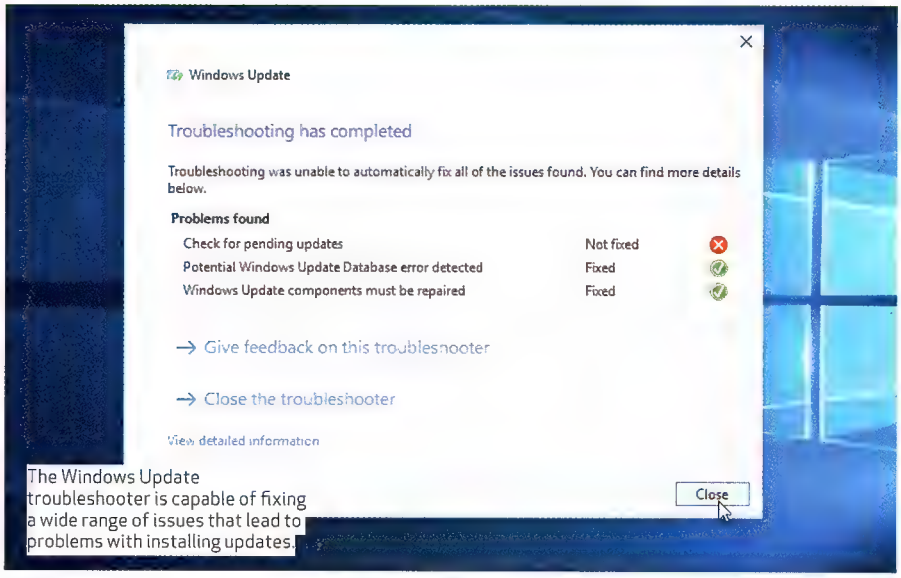
After rebooting, reopen the Windows Update Blocker tool and verify that the service is still disabled. Then go to 'Settings > Update & Security > Windows Update' where you should find everything appears normal. However, click 'Check for updates' and you'll immediately see an error, indicating it's been disabled.

Troubleshoot Windows Update

Sometimes the worst happens and an update to Windows goes wrong — don't panic! Just follow these tips to get yourself out of trouble.

Ideally, Windows Update should be virtually invisible, other than alerting you when updates are ready to be installed, and while they're being configured on startup.

We all know better of course. Some Windows updates might require two or three attempts before finally installing, while others may stubbornly refuse to install, full stop. Windows Update might even stop functioning completely, or your PC may suddenly refuse to reboot after you've installed the latest updates. So what's the solution?


Windows Update
Troubleshooting has completed
Troubleshooting was unable to automatically fix all of the issues found. You can find more details below.
Problems found
Check for pending updates
Not fixed
Potential Windows Update Database error detected
Fixed
Windows Update components must be repaired
Fixed
Give feedback on this troubleshooter
Close the troubleshooter
View detailed information
Close

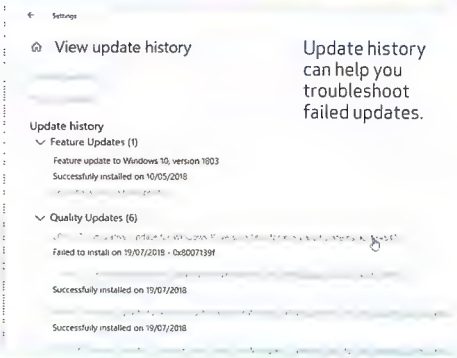
The Windows Update troubleshooter is capable of fixing a wide range of issues that lead to problems with installing updates.

GENERAL TROUBLESHOOTING

If Windows Update refuses to work correctly — for example, it throws up errors when you attempt to install an update or scan for updates, or you're struggling to install a specific update — start by running the Windows Update troubleshooter to see what it finds: if you use Windows 10 go to Settings › Update & Security › Troubleshoot, click the Windows Update link and click Run the troubleshooter; older versions of Windows hide the troubleshooter under 'Control Panel › System and Security › Action Center › Troubleshoot common computer problems'.

When the wizard opens, be sure to click Advanced and choose 'Run as Administrator' before clicking Next (Windows 7/8.1 only). Wait while the tool scans for issues — if it finds and fixes any, click 'View detailed information' if required to find out more about the fix, then click Close, reboot and try again. If the fix in question involves installing pending updates, but it's those updates refusing to install that is causing the problem, click 'Skip this fix' to keep searching for other potential issues.

If the problem persists, you may need to perform more drastic steps.

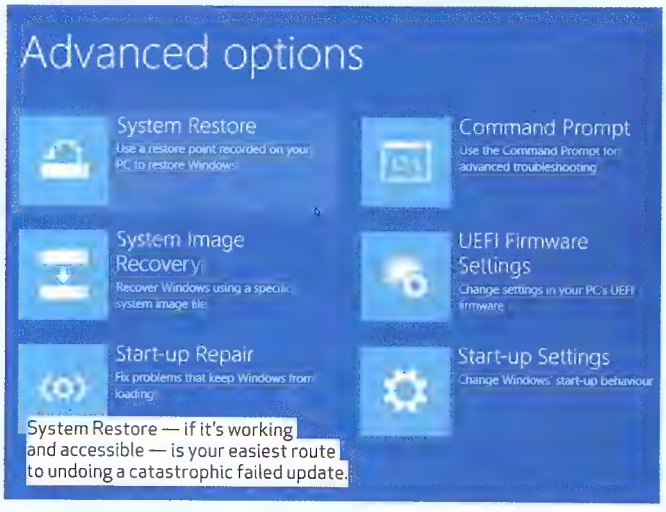


Update history can help you troubleshoot failed updates.

Windows won't boot!

It's rare — but not unheard of — for updates to screw your system up so much it can no longer boot into Windows successfully. After several failed attempts, Windows should give you the option of booting into Safe mode or bring up the recovery menu. From here try Startup Repair or System Restore to roll your PC back to the Restore point taken before the update was installed. Note: this may not be an option if you're running Windows 10 and didn't switch System Restore back on after installing the April 2018 Update.

Other options will involve recovery media — if you regularly back up using a tool like Macrium Reflect Free (**www.macrium.com/reflectfree**), roll back to your last backup using its boot media. Or you could boot from your Lazesoft Recovery Suite rescue media (**bit.ly/2LtlgPq**) and try its Windows Recovery tool. If it fails, use the Data Recovery component to save your data or take a disk image before booting from your Windows rescue or installation media and try a repair install — this involves installing Windows 7 over the top of itself, or performing an 'upgrade install' with Windows 8.1 and 10 boot media.


Advanced options
System Restore
Use a restore point recorded on your PC to restore Windows
Command Prompt
Use the Command Prompt for advanced troubleshooting
System Image Recovery
Recover Windows using a specific system image file
UEFI Firmware Settings
Change settings in your PC's UEFI firmware
Start-up Repair
Fix problems that keep Windows from loading
Start-up Settings
Change Windows start-up behaviour

System Restore — if it's working and accessible — is your easiest route to undoing a catastrophic failed update.

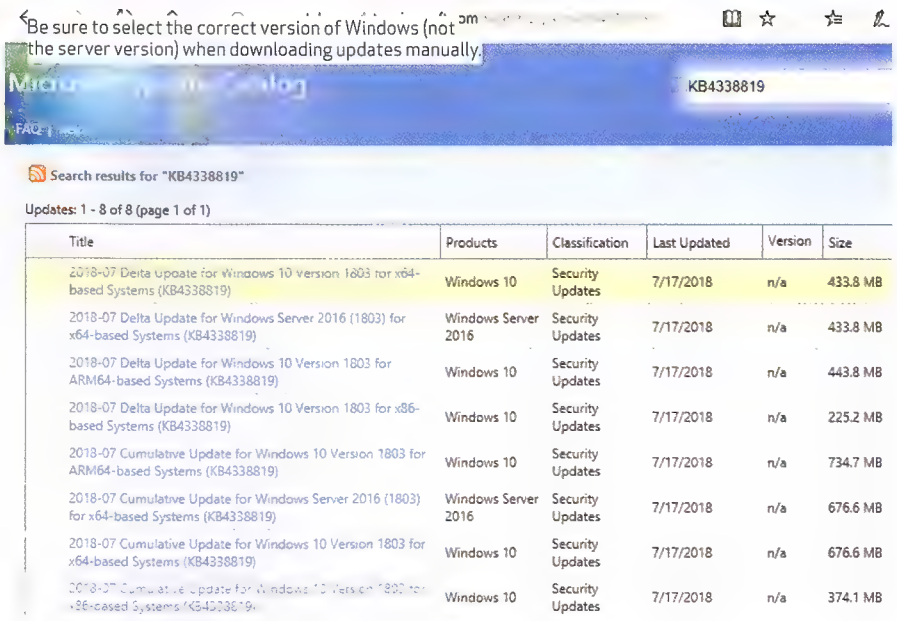
The 'Reset Windows Update' guide on the page opposite explains how you can use the Windows Repair Tool to get around this – you can download and install the tool (or extract the portable version) from **www.tweaking.com**. It will attempt a deeper fix via Safe Mode.

TROUBLESHOOT UPDATES

Often, the problem isn't with Windows Update itself, but a specific update that refuses to install. You may get advanced warning – a message during reboot that Windows is reversing a failed update – or your PC may keep attempting to install updates after every reboot. If the problem persists over two or three reboots, it's time to take further action.

Check the status of updates via the Windows Update tool. Simply click 'View update history' where you'll see a list of previously installed updates and whether they were successful or not. If there are multiple updates failing, then it's likely only one of them is the culprit. Windows 8.1 and 7 users can click to review updates, then select updates one at a time. This may be enough in itself (four stubborn updates on our Windows 8.1 PC all installed singly with no issues having failed to install together), or it will at least narrow down your search to the specific malfunctioning update.

Another possible fix is to download and install the troublesome update manually. Go to **www.catalog.update.microsoft.com** and search for the update number (including KB). You'll be given a list of matches based on Windows version, plus system architecture – x64 is for 64-bit versions of Windows, x86 for 32-bit.



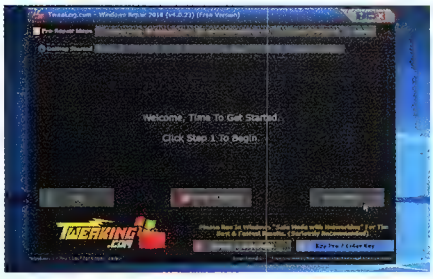
Download the file to your PC, then double-click it and follow the instructions to install it.

If this doesn't work, then you'll need to dig deeper. Any failed updates are accompanied by an error code in Windows 10; Windows 8.1 and 7 users need to double-click a failed update to review an error report including the error code. Older versions of Windows also provide a 'Get help with this error' link, although this usually fails to yield any meaningful results.

Instead, make a careful note of the error code and the update KB number. Google the code – try it with 'Windows Update', your version of Windows, the KB number or just on its own to see what you find. Ignore ads and focus on genuine websites, including reputable sources like **answers.microsoft.com**. Focus on newer results first, particularly if they correspond to your specific KB number.

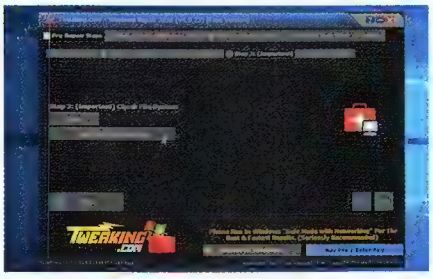
With a bit of luck, you should come across a solution found by other users – there's often no clear no rhyme or reason to certain updates failing, but if all of the troubleshooting techniques we've described here (including the Windows Repair tool) fail to yield a solution, don't panic: dig out your copy of APC 456 (July 2018) and refer to our huge guide to troubleshooting your PC starting on page 42.

Reset Windows Update



1 USE SAFE MODE

Press Windows-R, type `msconfig` and press Enter. Switch to the Boot tab and tick 'Safe boot', selecting Network. Click OK > Restart. Once logged into Safe Mode, launch Windows Repair and work through the initial steps to perform basic checks — ignore the power reset if your PC is otherwise OK.



2 PERFORM PRE-CHECKS

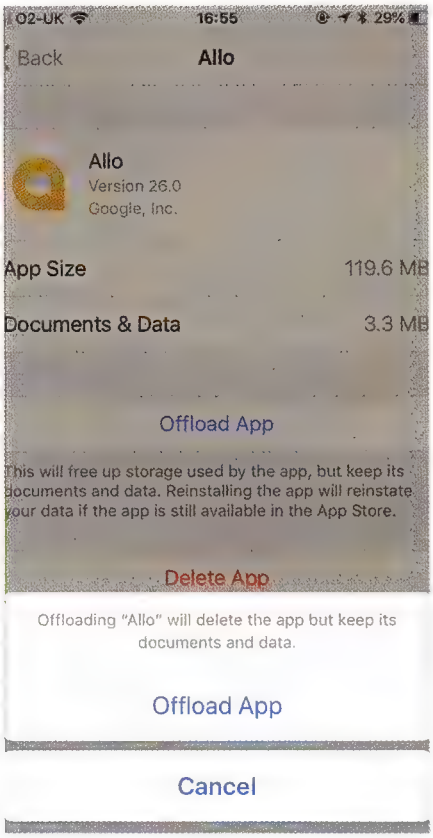
The other three steps — the pre-scan, disk check and System File Checker — are all essential in case your Windows Update problem is linked to disk errors or has missing or corrupt system files. Work through them one-by-one, rebooting where prompted and then returning to that point in the program.

3 APPLY REPAIRS

Once done, click Backup to back up the Registry and Create to create a system restore point. At the next screen you'll be prompted to either open Repairs or select a preset — select 'Preset: Windows Update'. Click 'Start Repairs'. When complete, return to msconfig and untick 'Safe boot' before rebooting your PC.

Offload and quickly restore little-used iOS apps

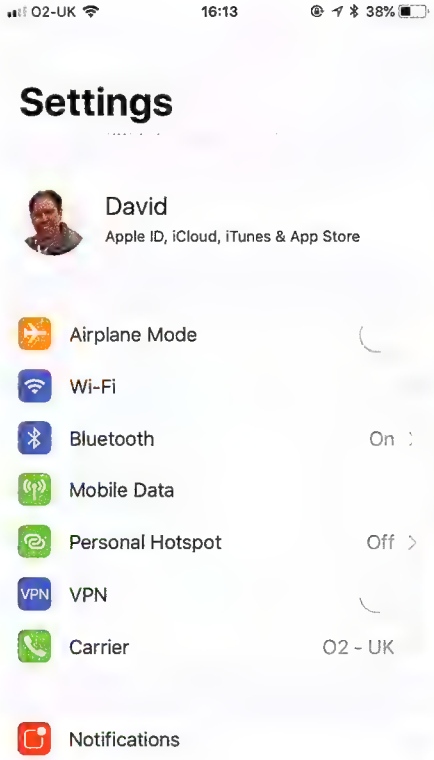
David Crookes shows you how to painlessly remove apps you haven't opened for a while and reinstall at a later date. .


O2-UK 16:55 29%
Back
Allo
Allo
Version 26.0
Google, Inc.
App Size 119.6 MB
Documents & Data 3.3 MB
Offload App
This will free up storage used by the app, but keep its documents and data. Reinstalling the app will reinstate your data if the app is still available in the App Store.
Delete App
Offloading "Allo" will delete the app but keep its documents and data.
Offload App
Cancel

Before, when you sought to free up space on your iOS device by removing the apps you barely use, there used to be one option: complete deletion. Since iOS 11, however, an alternative method called 'offloading' was introduced. Now, instead of permanently ridding an app and all of its data and documents, offloading retains the latter. You can reinstall an offloaded app once you need it and continue enjoying the information you'd once saved in it.

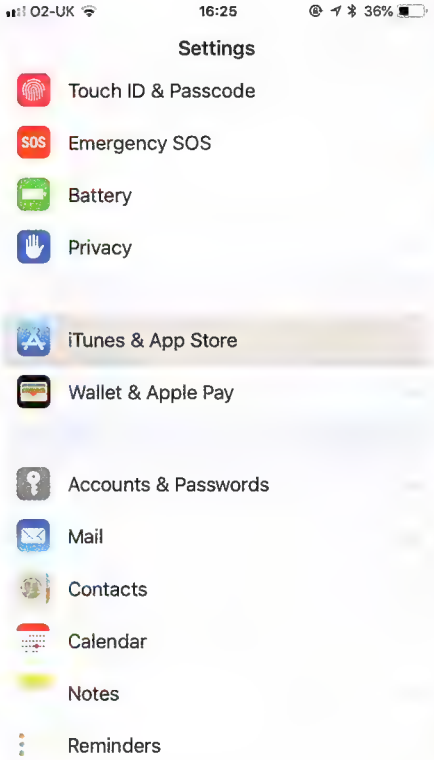
Here, we look at two ways of doing this. The first is automatic. Select this and Apple decides when it's time to offload an app, usually by figuring out how long it's been since you last used it. The second is manual and, in many ways, preferable because it puts you in greater control. It also protects against future problems, as we'll later see.

Automatically offload your unused apps



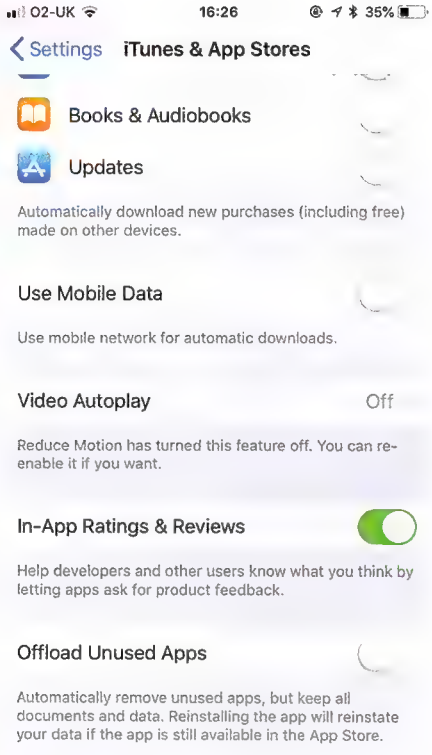
1 OPEN SETTINGS APP

With iOS 11, Apple sought to help you better manage your device's storage space by letting you automatically remove apps you barely touch. To activate, open Settings.



2 SELECT ITUNES OPTION

Now scroll down the screen until you see the option for 'iTunes & App Store' and tap on it. This will bring you to another bunch of settings — scroll to the bottom of them.


O2-UK 16:26 35%
Settings
iTunes & App Stores
Books & Audiobooks
Updates
Automatically download new purchases (including free) made on other devices.
Use Mobile Data
Use mobile network for automatic downloads.
Video Autoplay Off
Reduce Motion has turned this feature off. You can re-enable it if you want.
In-App Ratings & Reviews
Help developers and other users know what you think by letting apps ask for product feedback.
Offload Unused Apps
Automatically remove unused apps, but keep all documents and data. Reinstalling the app will reinstate your data if the app is still available in the App Store.

3 MAKE A CHOICE

By default, 'Offload Unused Apps' is off. However, some people have noticed that it sometimes turns itself on. Either way, now that you're here, you can make a decision.

Check your app use

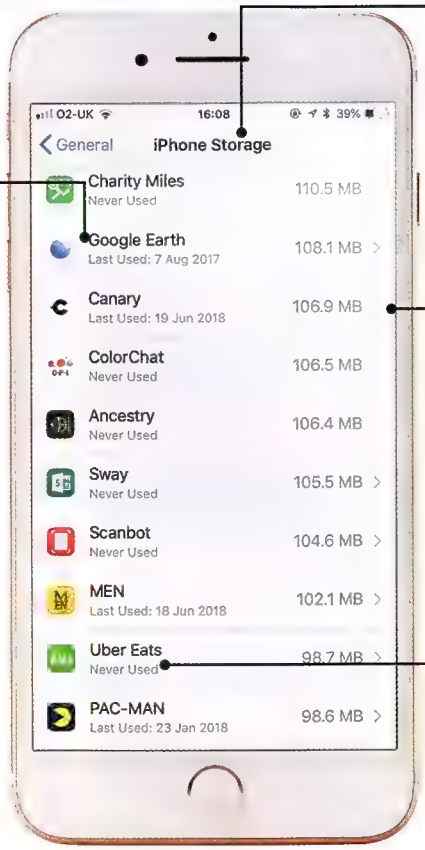
You can see how often you use your apps and decide if you want to manually offload them.

Offload apps

Apps that should be offloaded are those that you haven't used for a good while but which contain documents or data that you still want to retain for potential future use.

Reinstalling offloaded apps:

Offloading apps does not come without its pitfalls. A previously offloaded app may be removed from the App Store, in which case, you won't be able to reinstall it. It's a good idea to manually offload apps rather than let them be automatically removed, so you can weigh up the chances of them being pulled in the future.



iPhone Storage

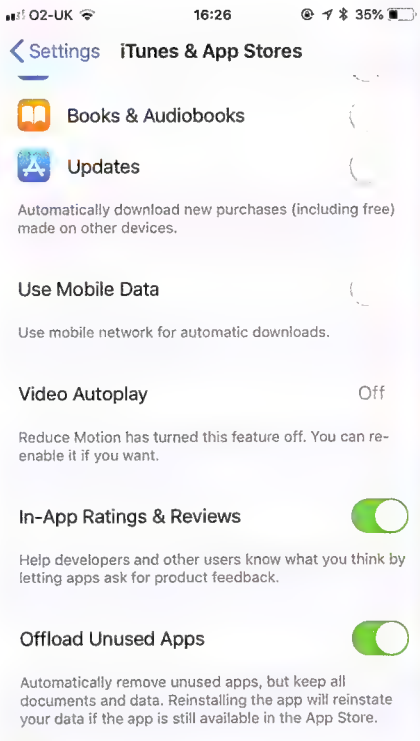
This screen shows the last time you used an installed app on your iOS device. You can reach it by going to 'Settings > General > Phone Storage' and scrolling down.

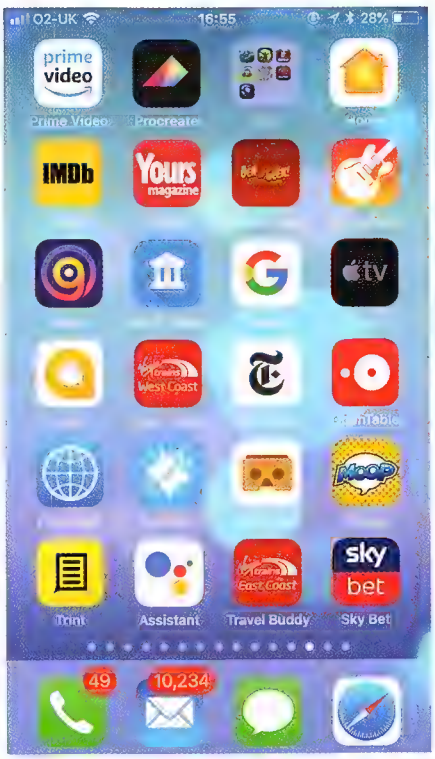
Select an app

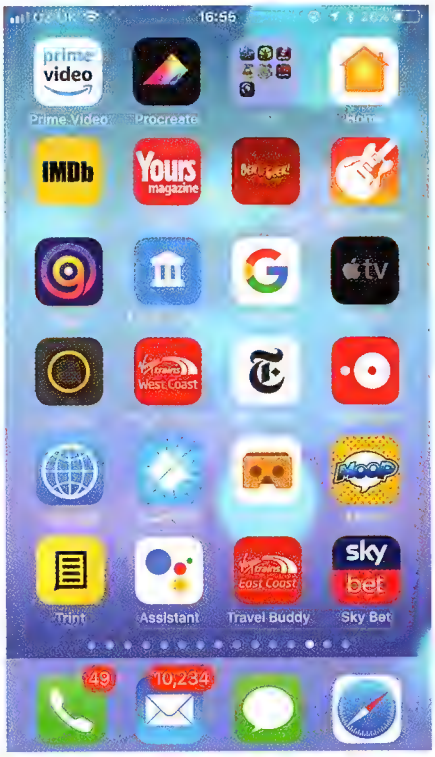
When you tap on one of the apps, you are shown the size of the app and its associated data. You can then choose to offload or delete by tapping the relevant option.

Delete apps

Some apps should be deleted rather than offloaded. The most obvious candidates for complete removal are those apps marked 'Never Used' unless, of course, you have important data stored within them.


O2-UK
16:26
35%
Settings
iTunes & App Stores
Books & Audiobooks
Updates
Automatically download new purchases (including free) made on other devices.
Use Mobile Data
Use mobile network for automatic downloads.
Video Autoplay
Off
Reduce Motion has turned this feature off. You can re-enable it if you want.
In-App Ratings & Reviews
Help developers and other users know what you think by letting apps ask for product feedback.
Offload Unused Apps
Automatically remove unused apps, but keep all documents and data. Reinstalling the app will reinstate your data if the app is still available in the App Store.





4 USE THE SLIDER

By ensuring this option remains off, your apps will permanently reside on your device. By turning it on, iOS 11 can check how often you're using an app and take action.

5 USE AN APP

After a while, if this feature is activated, offloaded apps will display a cloud icon next to their names. When you tap such an app, it will be reinstalled ready for use.

6 RETAIN YOUR DATA

The beauty of this method is that any documents or data stored by an offloaded app is not deleted. When an offloaded app reinstalls, the data is immediately available to you again.

Secure your Mac user account

Lock down your Mac and get up to speed with super-strong security. Alex Blake shows how.

Securing your Mac's user account doesn't have to be an arduous process. There are a few quick and easy tweaks you can do that will make a big difference.

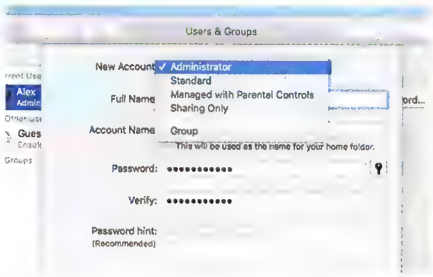
If you get locked out of your account, you can reset your password in macOS Recovery. But if you can do that, someone else can too. It's therefore a good idea to restrict access to Recovery by using a firmware password.

To enable that, restart your Mac and hold command-R until you enter macOS Recovery. Click Utilities in the menu bar, then choose Boot Security Utility (sometimes called Firmware Password Utility). Click Turn On Firmware Password, enter a strong password, click Set Password, then restart your Mac.

There are plenty of other options at your disposal. For example, it's a good idea to create a new admin user and remove the administrator privileges from your regular account. That way, powerful controls are locked behind a separate account. Read on for more super-secure suggestions.

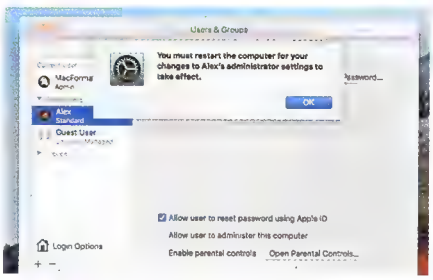
How to:

Switch to using a standard account



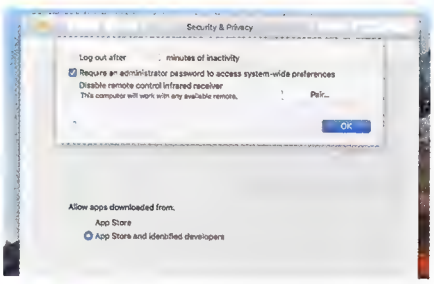
1 CREATE AN ADMIN USER

Go to the Apple icon > System Preferences > Users & Groups, then click the padlock and type your password. Click the + button, then select Administrator in the pop-up menu at the top and enter a new account's details. Click Create User.


Users & Groups
You must restart the computer for your changes to Alex's administrator settings to take effect.
OK
Guest User
Allow user to reset password using Apple ID
Allow user to administer this computer
Login Options
Enable parental controls
Open Parental Controls...

2 LIMIT YOUR ACCOUNT

Log out, then into the new admin account and return to Users & Groups; click the padlock and enter the admin's details. Select your usual account, untick 'Allow user to administer this computer' to make it a standard one, then restart.

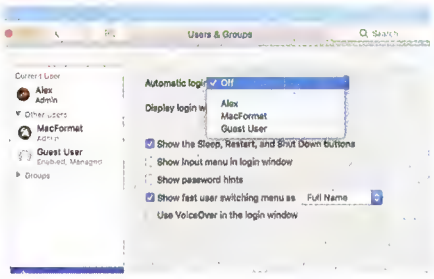


3 KNOW THE CONSEQUENCES

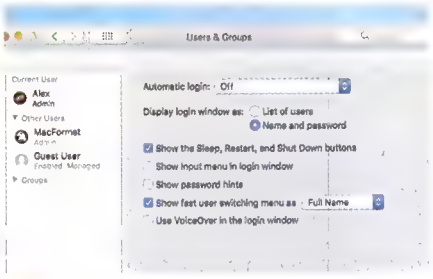
You'll see admin password prompts as you complete these steps. To be safe, go to the Security & Privacy pane and click Advanced, then tick the 'Require an administrator password to access system-wide preferences' checkbox.

How to:

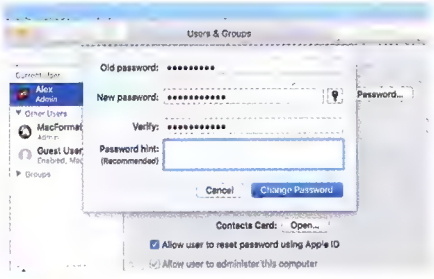
Set sensible login options


Users & Groups
Automatic login: Off
Alex
MacFormat
Guest User
Show the Sleep, Restart, and Shut Down buttons
Show input menu in login window
Show password hints
Show fast user switching menu as Full Name
Use VoiceOver in the login window

1 TURN OFF AUTOMATIC LOGIN
One of the most important things you can do is also one of the simplest. Go to Users & Groups and click Login Options. From there, make sure 'Automatic login' is set to Off. Your Mac will now ask for a password every time you start it up.


Users & Groups
Automatic login: Off
Display login window as: List of users
Name and password
Show the Sleep, Restart, and Shut Down buttons
Show input menu in login window
Show password hints
Show fast user switching menu as Full Name
Use VoiceOver in the login window

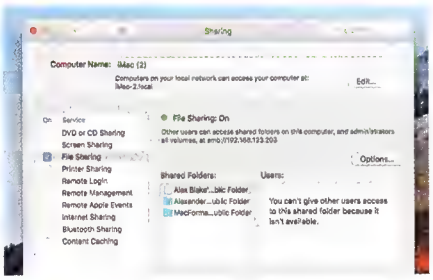
2 NAME AND PASSWORD
When you have multiple users, your Mac may show a list of accounts on the login window. In Login Options, change 'Display login window as' to 'Name and password' so would-be intruders have to know a username as well as a password.



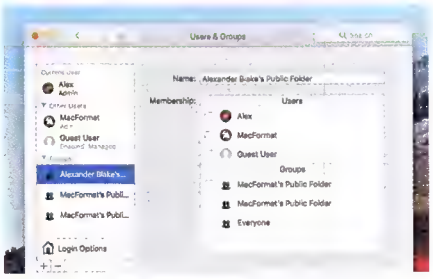
3 TURN OFF PASSWORD HINTS
While helpful, password hints can also be a liability by providing clues to your credentials. If you have a good memory, turn them off by clicking Change Password in the Users & Groups pane and removing the hint.

How to:

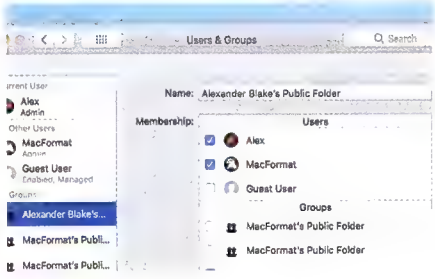
Power up searches with Manage shared folders



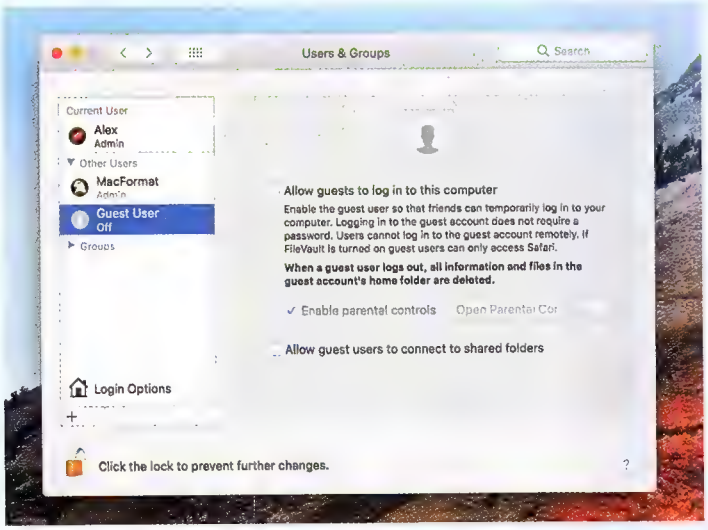
1 TURN ON FILE SHARING
If you want to share files from your Mac, you first need to go to the Sharing pane in System Preferences and turn on File Sharing. This shows you what folders you're sharing and with whom, and what access they have to your shared folders.



2 USERS & GROUPS
If you want to make further tweaks to the shared folder settings, go to Users & Groups in System Preferences. Expand the Groups folder on the left-hand side to see a list of the groups that your Mac is currently part of. Select one of them.



3 SET MEMBERSHIP ACCESS
The Membership section allows you to choose which user accounts (on your Mac) and groups (that you're connected to) can access your shared folders. Click the tickboxes to allow or restrict access for each user and group.


Users & Groups
Search
Current User
Alex
Admin
Other Users
MacFormat
Admin
Guest User
Off
Groups
Allow guests to log in to this computer
Enable the guest user so that friends can temporarily log in to your computer. Logging in to the guest account does not require a password. Users cannot log in to the guest account remotely. If FileVault is turned on guest users can only access Safari.
When a guest user logs out, all information and files in the guest account's home folder are deleted.
Enable parental controls
Allow guest users to connect to shared folders
Login Options
Click the lock to prevent further changes.

Manage the Guest user account

Add extra security and lock things down.

Your Mac automatically creates a guest user account that doesn't require a password. If you know you'll never need it, the best option is to turn it off. Go to Users & Groups, click the Guest User and untick 'Allow guests to log in to this computer'. This pane also lets you block guest access to shared folders. If you want to restrict guest access to certain apps, click Open Parental Controls, enter an administrator's credentials and then choose whether you want to restrict the use of your Mac's camera, apps, Mail and games.

Secure your Linux desktop

Linux can thwart a majority of attacks on its own, but Mayank Sharma's on hand to help you put up a level 10 force-field around your computer.

Running Linux just because you think it's safer than Windows? Think again. Security in Linux is a built-in feature and extends right from the kernel to the desktop, but it still leaves enough room to let someone muck about with your /home folder. Sure, Linux is impervious to viruses and worms written for Windows, but attackers have several other tricks up their sleeves to illegally access your precious bits and bytes that make up everything from your personal emails to your credit card details.

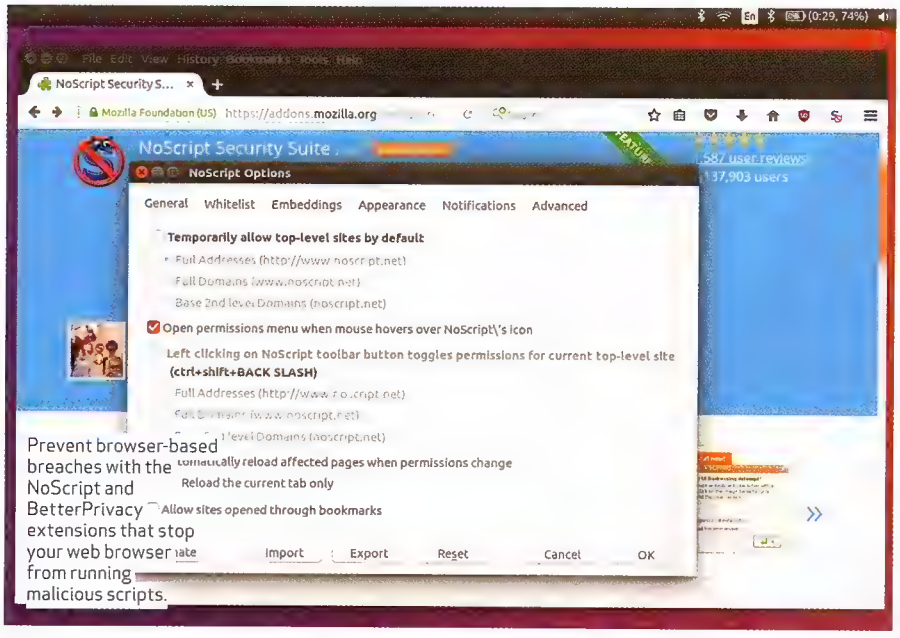
Locking your data behind a username and password shouldn't be your only line of defence, and isn't enough to hold off a determined attacker. As the number, nature and variety of computer attacks escalate every day, you too should go out of the way and take extra measures to secure your computer against unauthorised access.

All mainstream Linux distributions such as Debian, Ubuntu and Fedora have security teams that work with the package devs to make sure you stay on top of security vulnerabilities. Generally, these teams work with each other to make sure that security patches are available as soon as a vulnerability is discovered.

Your distribution will have a repository dedicated to security updates. All you have to do is make sure the security-specific repository is enabled (chances are it will be, by default), and choose whether you'd like to install the updates automatically or manually at the press of a button. For example, from the Updates tab in the Software & Updates app, you can ask Ubuntu to download and install security updates automatically.

In addition to the updates, distributions also have a security mailing list to announce vulnerabilities, and also share packages to fix them. It's generally a good idea to keep an eye on the security list for your distro, and look out for any security updates to packages that are critical to you. There's a small lag between the announcement and the package being pushed to the repository; the security mailing lists guide the impatient on how to grab and install the updates manually.

You should also take some time to disable unnecessary services. A Linux desktop distro starts a number of services to be of use to as many people as possible. But you really don't need all these services. Samba, for example, shouldn't really be enabled on a secure server, and why would you need the Bluetooth service to connect to Bluetooth devices on a computer that doesn't have a Bluetooth adapter? All distributions enable you to control the services that run on your Linux installation usually with a built-in graphical utility. However, some applications might stop functioning because you decided to disable a service on which they rely. For example, many server applications rely on databases, so before you turn off MySQL or PostgreSQL you should make sure you aren't running any applications that rely on them.



Prevent browser-based breaches with the NoScript and BetterPrivacy extensions that stop your web browser from running malicious scripts.

SECURE USER ACCOUNTS

On a multi-user system like Linux, it's imperative that you limit access to the super-user root account. Most distributions these days don't enable you to log in as root at boot time, which is good. Furthermore, instead of giving multiple people root permission, you should grant root access on a per-command basis with the `sudo` command. Using `sudo` instead of logging in as the root user has several advantages. All actions performed with `sudo` are logged in the /var/log/secure file, which also records all failed attempts.

One of the major advantages of using `sudo` is that it makes it possible to restrict root access to certain commands. For this you need to make changes in the /etc/sudoers file, which should always be edited with the `visudo` command. This command locks the sudoers file, saves edits to a temporary file and ensures the configuration is correct before writing it to /etc/sudoers. The default editor for `visudo` is vi.

To enable a user named 'admin' to gain full root privileges when they precede a command with `sudo`, add the following line in the /etc/sudoers file:

```
admin    ALL=(ALL) ALL
```

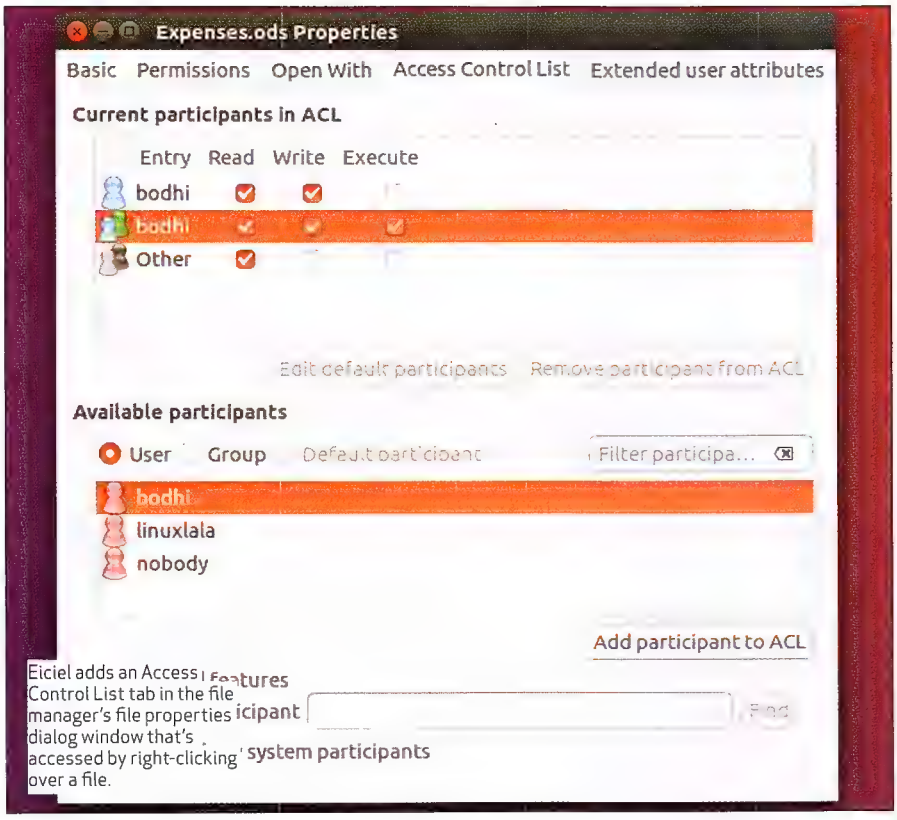
To make it possible for a user named Joe to run all commands as any user but only on the machine whose hostname is viperhost, add

```
joe    viperhost=(ALL) ALL
```

You can also restrict access to certain commands. For example, the following line will only enable a user called Susie to run the kill, shutdown, halt and reboot commands:

```
susie        ALL = /bin/kill, /sbin/shutdown, /sbin/halt, /sbin/reboot
```

Similarly, a user called Jack can only add and remove other users, like so:




```
jack    ALL = /usr/sbin/adduser
```

You can also restrict a user's scope. The following enables the user named Nate to kill unresponsive processes, but only on his workstation named Tango and not anywhere else:

```
nate    tango = KILL
```

On a related note, you should also set expiration dates for accounts used by non-permanent users. This can include any interns, temporary employees and consultants who need to access your Linux installation. Ideally, you should immediately deactivate and remove the temporary accounts as soon as they aren't required. The expiration date acts as a safeguard to ensure these accounts can't be misused.

Use the `usermod` command to tweak a user's account and set an expiration date, such as:

```
$ sudo usermod -e 2018-09-02 bodhi
```

In this example, the user named Bodhi won't be able to log into the account from September 2, 2018.

PERMISSIONS PRIMER

Another important part of securing your Linux system is setting proper permissions. In Linux and Unix, everything is a file. Directories are files, files are files and devices are files. Every file and program must be owned by a user. Each user has a unique identifier called a user ID (UID), and each user must also belong to at least one group, which is defined as a collection of users that has been established by the system administrator and can be assigned to files, folders and more.

Users may belong to multiple groups. Like users, groups also have unique identifiers, called group IDs (GIDs). The accessibility of a file or program is based on its UIDs and GIDs. Users can access only what they own or have been given permission to run. Permission is granted because the user either belongs to the file's group or because the file is accessible to all users. The one exception is the root or superuser who is allowed to access all files and programs in the system. Also, files in Linux have three kinds of permission associated to them – users, groups and others – that determine whether a user can read, write or execute a file.

You can view the permissions of a file or directory with the `ls -l` command. The command to use when modifying permissions is `chmod`. There are two ways to modify permissions: with numbers or with letters. Using letters is easier to understand for most people, but numbers are much better once you get used to them. The table (over the page) lists the chmod values for each of the permission types.

For example, `chmod u+x <somefile>` gives execute permissions to the owner of the file. The `chmod 744 <somefile>` does the same thing, but is expressed in numbers. Similarly, `chmod g+wx <somefile>` adds write and execute permission to the group while `chmod 764 <somefile>` is how you'll express it with numbers.

However, this arrangement can't be used to define per-user or per-group permissions. For that, you need to employ access control lists (ACL) that enable you to specify elaborate permissions for multiple users and groups. While you can define them manually, graphical tools such as Eiciel make the process more intuitive and help you save a lot of time and effort. You can install Eiciel from the repos of most major desktop distributions. Once installed, the tool can be used to fine-tune the access permissions for each individual file.

To get a better hang of the filesystem permissions on Linux, let's put them into practice to lock sensitive files, such as the ones that house password information. The file should belong to the root owner and

Keep an eye on processes

Virtually all malicious activity happens via processes running in the background.

As part of your active security management plan, you should keep an eye on the running processes on your machine and immediately take action against any suspicious processes. You can use the top command to list all the running processes and highlight how they're consuming the available resources on your computer. If you want a more user-friendly version of the running processes, install the htop utility from the repos.

Every process is assigned a process ID, or PID, which helps identify and keep track of individual processes. Use the pgrep command to list the PID if a process, such as pgrep vlc. To kill a process you can use the kill command followed by the PID (Process ID) of the unrecognised program.

For example, `kill -9 1934` will instruct the Linux kernel to shut down the program associated with the specified PID. You can also kill a process from within the top utility. Press K and then type the PID of the process to terminate it.

group with 644 permissions. This enables users to log in and view the associated username. However, it will prevent them from modifying the /etc/passwd file directly. Then there's the /etc/shadow file that contains encrypted passwords as well as other information, such as account or password expiration values. The owner of this file is the user root while the group is often set to an admin group, like shadow. The permissions on this file are set to 000 to prevent any user from even reading it.

Still, while there's no access permission on the file, the root user can still access it. But if no one can access the file, how can users change their passwords that are stored in this file? This is because the /usr/bin/passwd utility uses the special permission known as SUID. Thanks to this special provision, the user running the passwd command temporarily becomes root while the command is running and can then write to the /etc/shadow file. Similarly, the /etc/group file that contains all the groups on the system should have the same file permissions as the /etc/passwd file. In the same vein, the group password file /etc/gshadow should have the same permissions as /etc/shadow.

MANAGE PASSWORDS WITH PAM

The pluggable authentication modules (PAM) mechanism was originally implemented in the Solaris operating system, but has been a Linux mainstay for quite a while now. PAM simplifies the authentication management process and provides a flexible mechanism for authenticating users and apps.

In order to reap the benefits of PAM, individual applications have to be written with support for the PAM library. The command

```
ldd /{,usr/}{bin,sbin}/*
|grep -B 5 libpam | grep '^/'
```

will display a list of all the programs on your system that are PAM-aware in some way or the other. From the list you'll notice that many of the common Linux utilities make use of PAM.

You can also use PAM to force users to select a complex password. PAM stores its configuration files under the /etc/pam.d directory. Here you'll find a configuration file for virtually all the programs that request PAM authentication. When you look inside these configuration files, you'll notice that they all begin with calls to include other configuration files with the common- prefix. For example, the /etc/pam.d/passwd file calls the common-password file. These common-prefixed files are general configuration files whose rules should be applied in most situations.

The common-password file controls password complexity. The

```
cat /etc/pam.d/common-
password | grep password
```

command will list the relevant lines that define the basic rules for passwords, such as:

```
password    [success=1
default=ignore]    pam_unix.
so obscure sha512
password    requisite
pam_deny.so
password    required
pam_permit.so
password    optional
pam_gnome_keyring.so
```

We're interested in the first line that defines the rules for passwords. Some rules are already defined, such as asking for passwords to be encrypted with the SHA512 algorithm. The obscure parameter ensures complexity based on various factors such as previous passwords, number of different types of characters and more.

For more password-checking capabilities, let's install an additional PAM module with sudo apt install libpam-cracklib . Installing this module will automatically change the /etc/pam.d/common-password file that lists the following additional line:

```
password    requisite
pam_cracklib.so retry=3
minlen=8 difok=3
```

This line enables the pam_cracklib module and gives the users three chances to pick a good password. It also sets the minimum number of characters in the password to eight. The difok=3 option sets the minimum number of characters that must be different from the previous password.

You can append remember=5 on this line to prevent users from setting the five most recently used passwords. You can also use the dcredit , ucredit , lcredit and ocredit options to force the password to include digits, upper-case characters, lower-case characters and special-case characters. For example, you can use the following code to force the user to choose a password that's not the same as the username and contains a minimum of 10 characters with at least four digits, one upper-case character, and one special character:

```
password    requisite
pam_cracklib.so dcredit=-4
ucredit=-1 ocredit=-1
lcredit=0 minlen=10 reject_
username
```

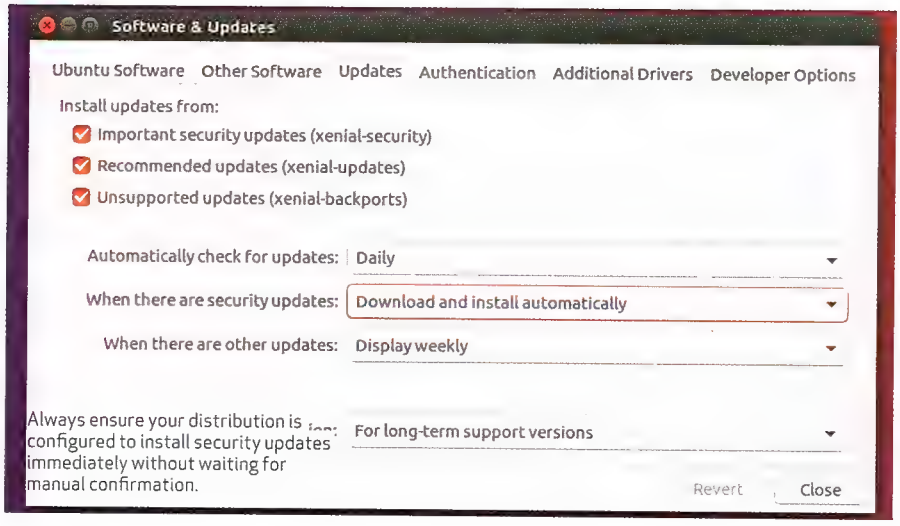
OBFUSCATE YOUR STUFF

One of the best ways to keep your personal data to yourself is to encrypt it, so others can't read the files. To this

ACCESS AND USER RESTRICTIONS

PERMISSION	ACTION	CHMOD OPTION
READ	(VIEW)	R OR 4
WRITE	(EDIT)	W OR 2
EXECUTE	(EXECUTE)	X OR 1

USER	LS -L OUTPUT	CHMOD OPTION
OWNER	-RWX------	U
GROUP	----RWX---	G
OTHER	-------RWX	O



end, the installers of some leading distributions make it possible for you to encrypt your entire disk during the initial setup of the distro.

If you wish to encrypt individual files, however, you can use the zuluCrypt application. This blocks device encryption, which means that it encrypts everything written to a particular block device. The block device can be a whole disk, a partition or even a file mounted as a loopback device. With block device encryption, the user creates the filesystem on the block device, and the encryption layer transparently encrypts the data before writing it to the actual lower block device.

Using zuluCrypt, you can create an encrypted disk within a file or within a non-system partition or USB disk. It can also encrypt individual files with GPG. ZuluCrypt has an intuitive user interface; you can use it to create random keyfiles and use these to encrypt the containers. The program also includes the zuluMount tool that can mount all encrypted volumes supported by zuluCrypt.

To install zuluCrypt head to **http://mhogomchungu.github.io/zuluCrypt/** and scroll down the page to the binary packages section. The program is available as installable .deb package files for Debian and Ubuntu. Download the package for your distro and extract it with `tar xf zuluCrypt*.tar.xz` . Inside the extracted folder, switch to the folder corresponding to your architecture (i386 for older 32-bit machines and amd64 for new 64-bit ones). Both folders contain four binary packages that you can install in one go with the sudo dpkg -i *deb command. On other distributions you'll have to install zuluCrypt manually. Download the app's tarball and follow the detailed steps in the included BUILD-INSTRUCTIONS file to fetch the dependencies from your distro's repos.

Disaster recovery

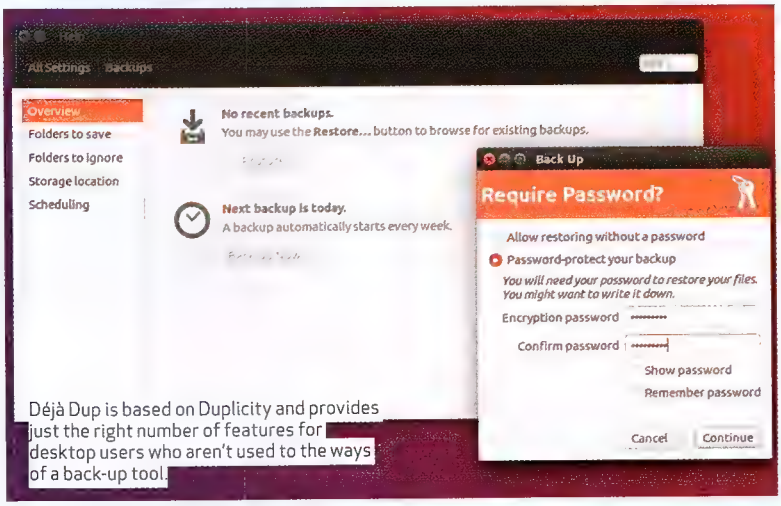
A strategy for recovering from a breach that results in data loss should be part of your security plan.

There are several backup utilities available for the Linux desktop user and your distribution will have one installed by default. Ubuntu, for example, ships with Déja Dup that you can also install on other distributions such as Fedora, OpenSUSE and Linux Mint.

Almost every backup application will ask you to point it to the location where you want to house your backups. Depending on the tool you're using, this can be a local hard disk, a remote location accessible via SSH or FTP, or a web-based storage service, such as Amazon S3. You'll also have to mark files and directories that you want to include in the backup. Some tools will also help you set up a backup schedule to automate the process. Tools such as Déja Dup will also enable you to encrypt your backups.

While Déja Dup and the like take the pain out of setting up the actual data backup process, a crucial part of the process is preparing for it. For starters, you need to decide on a location for storing the backed-up data. If you have multiple disks and a spare computer you can even set up your own network attached storage (aka a NAS) device using software like OpenMediaVault.

The kind of data you wish to back up also influences the choice of storage medium. You'll also need to work out the appropriate backup methodology. Do you want to back up manually, or automatically based on a schedule? The correct backup frequency varies based on the kind and value of data being safeguarded. Depending on the size of the files, it might not be a good idea to back them up completely every day, either.



Déjà Dup is based on Duplicity and provides just the right number of features for desktop users who aren't used to the ways of a back-up tool.

PUT UP A FIREWALL

Linux distributions comes with the venerable netfilter/iptables framework. This is a set of kernel modules that can be utilised to create packet filtering rules at the kernel level. Ubuntu ships with the Uncomplicated FireWall (UFW), which is a userspace application that can be used to create iptables rules.

There's also a GUI for UFW called Gufw. It takes the pain out of managing iptables. The program can easily allow or block services as well as user-specified ports. You configure your policy based on pre-installed profiles for Home, Public and Office and set the policies for incoming and outgoing traffic. The default configuration should satisfy most of the users, although you can set individual rules if you wish for a more advanced configuration.

Begin by first enabling the firewall. Once enabled you can set the Incoming and Outgoing policies by selecting one of the three options in the drop-down menus. The Allow option will permit traffic without asking any questions. The Deny option will silently discard all incoming or outgoing packets. The Reject option is different in that it sends an error packet to the sender of the incoming packets.

After you've set the policy for both Incoming and Outgoing traffic you can define specific rules for individual programs and services. To create a rule, click the Add button after expanding the Rules section. This opens a window that offers three tabs that enable the creation of rules in different ways. The Preconfigured option enables you to select ready-made rules for specific programs or services, while the other two enable you to define rules for specific ports.

We'd suggest that most users should stick to the Preconfigured tab. All you need to do is select the program you wish to control traffic for from the dropdown menu and Gufw will automatically define the most effective rules. As mentioned earlier: for a secure system, you should drop all incoming and outgoing traffic and then selectively add rules for the programs and services that you use, such as the web browser, instant messaging and BitTorrent.

Water walking with Ryzen

Zak Storey walks you through the trials and tribulations of building one of the world's most compact liquid-cooled rigs.

THE CONCEPT

This month's PC build differs from most of our usual projects: it's devised with a single person in mind, as opposed to trying to hit a specific price point, use case... or just pushing everything to the max, like we do with our most aspirational builds.

This machine is designed around the whims of our crackpot editor. ITX builds are a passion, and pushing as much power as possible into as small a form factor as possible is incredibly enticing. In fact, it's arguably what this industry has been all about for the last 60 years – enabling more and more performance out of less and less space.

That said, this build project didn't actually start out with ITX in mind. There have been numerous revisions, countless spec list changes, and a whole heap of adjustments made before even getting to this point. Originally, we planned to take advantage of Intel's perfectly balanced Core i9-7900X – delidded, of course – housed in an Enthoo Evolv ATX. Then, with the advent of Spectre and Meltdown, we transferred our proposition over to the notion of Ryzen once more – a Ryzen+ build, to be exact – but still taking advantage of that ATX form factor, and with an SLI ASUS GTX 1080 Ti configuration. Fast-forward to this month and that notion was finally shrunk down to an ITX system, and a second look at a custom-modded NZXT Manta, a chassis we'd worked on in the past. After we realised our custom case ideas couldn't be brought to fruition in time for getting the issue to print, we finally settled on working with Lian Li's PC-Q37 – only for the spec to then get shaken up once again, with the launches of Samsung's 970 Pro drives and ASUS's X470-I motherboard.

In the run-up to this issue, it's been hectic, to say the least. The organisational side of things has been turned on its head so many times, it's been enough to drive the chief colour picker insane, and for the design team at *APC* to put out hits on all of us – the editor in particular. Stress, upon stress, upon stress. Why do we do this again?

LIQUID LUXURY

Every time we hit up the drawing board for a build like this, there's a sense of apprehension. The degree of organisation and luck required is Herculean, and even with all our experience, it never comes easy.

From planning the spec list, to requesting hardware, arranging photography, and more, it can take months for everything to come together, only for a new product to launch, or a shipping deadline to fall through, and scupper the entire thing.

Unlike our regular builds, these one-off specials are not about absolute power, and pushing everything to the bleeding edge of technology, but about crafting a PC that's perfect for the individual it's designed for.

Let's be realistic: you can probably get the same performance for half the cost, or twice the performance for less than double the price. But you rarely find someone who's invested this much time and effort into a rig and regrets it. It's a real labour of love.

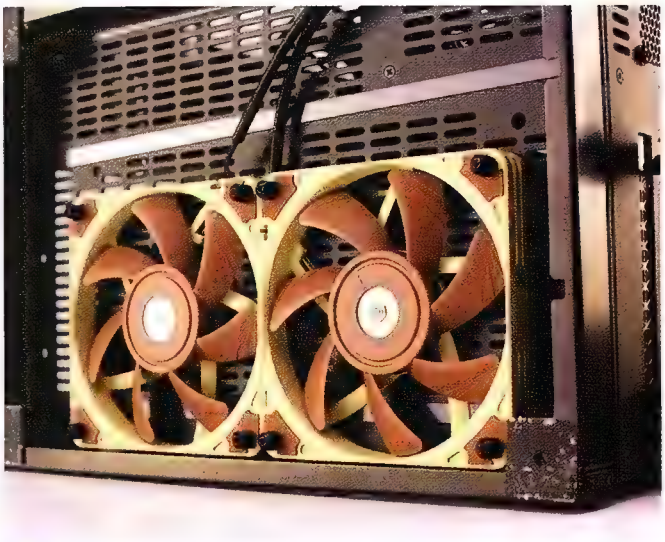
This time around, we'll be crafting a super-small liquid-cooled ITX Ryzen 2 rig, packing some incredible hardware into as small a chassis as possible. On top of that, we'll be divulging all our tips and tricks to make the micro manageable, giving up our secrets on exactly which manufacturers and products we chose to make our system build as easy as can be, and hopefully inspiring you to create your own slice of silicon perfection, on any budget, in any chassis.

PARTS LIST

PART		STREET PRICE
CPU	AMD RYZEN 7 2700X	$469
GPU	NVIDIA GEFORCE GTX 1080 TI	$1,149
MOBO	ASUS ROG STRIX X470-I GAMING	$319
RAM	32GB (2X 16GB) KINGSTON HYPERX PREDATOR DDR4 @ 3,000MT/S	$620
STORAGE 1	512GB SAMSUNG 970 PRO PCIE M.2 SSD	$399
STORAGE 2	1TB SAMSUNG 860 EVO SATA M.2 SSD	$330
CASE	LIAN LI PC-Q37	$360
PSU	SILVERSTONE SX800-LTI SFX 800W	$199
FANS	4X BE QUIET! SILENT WINGS 3 120MM PWM HIGH SPEED	$116
LIQUID COOLING	ASSORTED ALPHACOOL PARTS	$1,831
CABLES	CABLEMOD CONFIGURATOR PRO + LED STRIP	$219
OPERATING SYSTEM	WINDOWS 10 HOME OEM	$140
TOTAL		$6,151

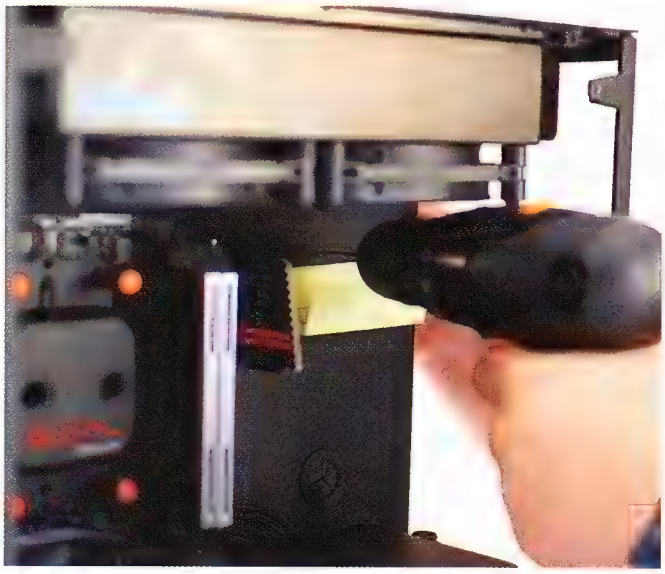
1 PRELIMINARY FITTING

Step one: the doozy — the strip-down. It's so, so, so important you get this right, especially in a liquid-cooled build, particularly when it's as tight and cramped as this, because it's the perfect opportunity to see where your radiators fit, and try to figure out your tubing runs, and where you might need pass-throughs. In our case, we knew ahead of time we'd need every edge we could get. That meant reducing physical drives, cable clutter, anything that might cause an issue. The hard drive cage and grommet covers were all removed prior to the build shoot. Once we began, we got the motherboard set up ASAP — that meant CPU in, block on, memory in, and M.2 storage in. Once that was all secured, we quickly installed it to see exactly where we'd need to fit everything else.



2 RADIATOR CONUNDRUMS

We knew this build was going to struggle with airflow. Having no traditional front panel meant air access came from the bottom and top — and that was it. Problem is, there isn't enough space to mount fans in the bottom if you're using an additional radiator there as well. To get around this, we decided to invest in two slim 120mm Noctuas, and mount them on the underside of the chassis. We also had to move the radiator as far forward as we could to make sure the fittings wouldn't be blocked by the GPU. We used rubber washers with the screws, to secure the fans to the radiator, as they're 10mm slimmer than their standard counterparts, and we needed to make that up somehow. There's a few adjustments we can still make. In an ideal world, we would replace the feet with aftermarket custom-cut acrylic ones, to give the chassis more height, and allow us to use full-sized, more powerful Noctuas instead. Couple that with some fan guards, and we'd be good to go.

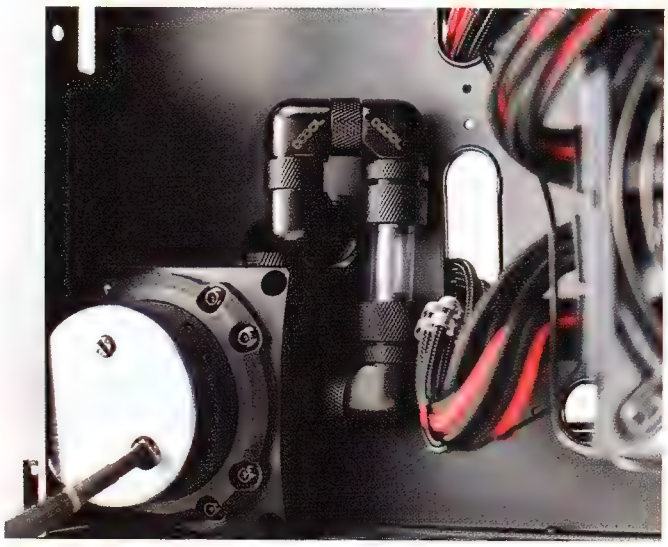


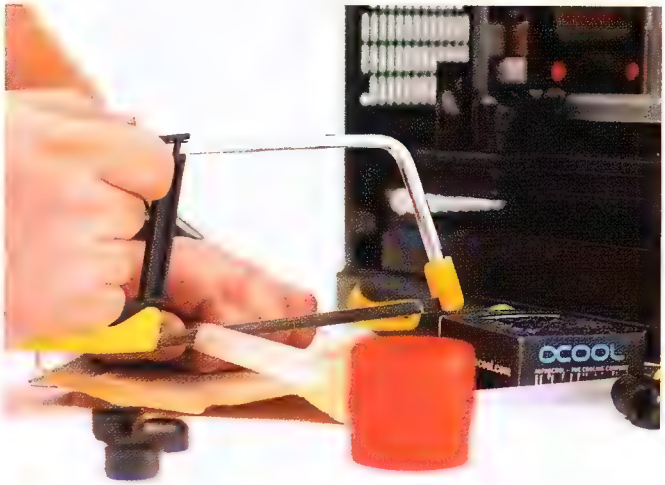
3 FAT FITTINGS

More radiator challenges: this time from the top thick-as-hell 45mm rad. By default, the bigger 45s come with a massive reservoir at the end, alongside six individual G1/4-inch mounting holes (seven if you include the one at the other end), all of which need plugging. It's great for choices in loop orientation, less so when you're mounting them to flush radiator brackets, like the one on the PC-Q37. As these stop fittings were pushing the rad down, we took the radiator mounting bracket out of the chassis, marked up where the fittings were going to go, found the centre using a rule, drilled a pilot hole, then used a mandrel to take out the rest, allowing the fitting to pass through unhindered, and reducing our clearance issues. There's another removable brushed aluminium panel that sits on top of this, so our handiwork is hidden, but it'll also act as a drain valve or fill port when we have to do some loop maintenance.

4 RESERVOIR MOUNTING BRACKET

Next up on the list of modifications to the chassis (and the first appearance of our bearded modding assistant) is a reservoir mounting bracket. We didn't really need to add this bracket, as the reservoir is secured by two 15mm-long extension fittings coming off the bottom radiator, and a second fitting coming out of the bottom-right of the res, connecting to a future drilled pass-through, going through the motherboard panel and into the pump, hidden on the other side. That said, to keep our res sitting proud and level, adding this bracket (included with the res) makes sense. Using a permanent marker, and some extra hands to hold the res in place, we marked the holes we needed to drill, before pumping through that soft gooey aluminium with a standard 4mm drill bit. You might notice the use of a sticky note here; fold it to create a tray, and attach it below where you intend to drill, to catch all the metal filings.





5 PUMP SHENANIGANS

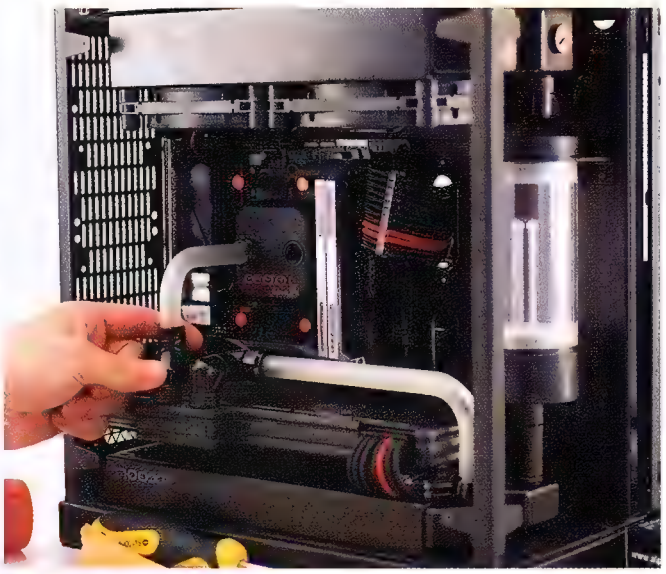
This part was possibly the most frustrating. From past experience, we knew soft tubing in the rear of the case was going to make our lives easier. Unfortunately, due to the lack of room and the need for pass-throughs in places for the reservoir, the tight curves led to the most obvious tubing runs kinking, which is bad. In the end, just to fit the pump in the chassis, we had to remove one of the plastic grommets that hold the side panel in place (there are seven in total, so losing one isn't the end of the world), then run four 90-degree fittings, with the smallest slither of soft tubing between to reach the pump inlet. To finish the loop, we ran an additional length of soft tubing straight up from the left-hand side of the pump to a second pass-through in the roof, connecting to the radiator on the other side.

6 CUTTING BLIND

We know what you're thinking: no guide, no securing tool, cutting straight down on a table, with a hacksaw? What? Don't worry. You can be super-anal about cutting tubing, but you don't need to be. It doesn't even need to be that straight a cut. The best way to cut tubing is to work out how long a length you need, and cut it with a hacksaw, in as comfortable a position as possible. Make sure you stay safe, of course, and cut off more than you think you'll need, but if you mess up the end, don't sweat it. If the cut is wonky, use sandpaper or needle files to smooth the rough edges and make it level. Next, use a deburring tool to give your tube some soft edges, making it easier to fit, then sand it some more to get rid of the grit, blow it out, and bam! Job done: one straight, level, chamfered, clean tube.

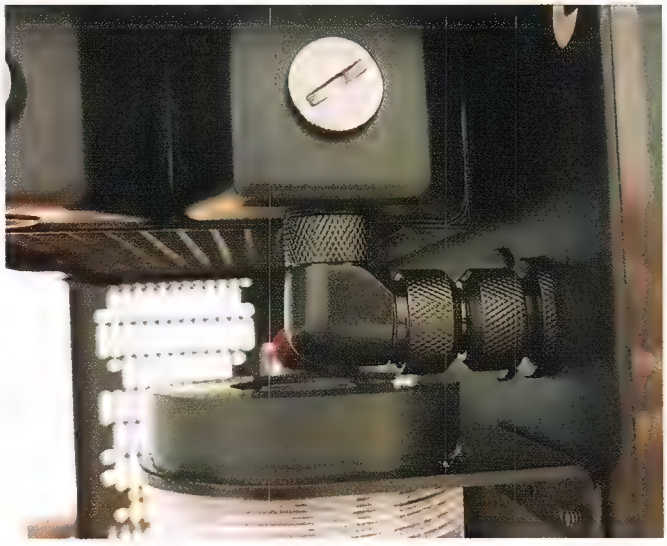
7 90 DEGREES 4 LYF

There's a phrase we always repeat to ourselves whenever it comes to building liquid-cooled rigs: "Keep it simple, stupid." This is especially relevant with tubing runs, where it's almost always a better decision to use a fitting in place of a bend, unless there's no other option. If you do want bends in your tubing, the best way to integrate them is through pure 90-degree angles. They're the simplest and quickest bend to create — you don't need any carefully crafted angle templates or anything weird, because the whole world is literally filled with 90-degree angles. Us humans, we love square edges. In this case, to make our bends, we're using the edge of the chassis itself to line up our 90-degree angle, mid-bend, to make sure it's the perfect shape. This particular tube will go on to become our CPU-to-GPU line.



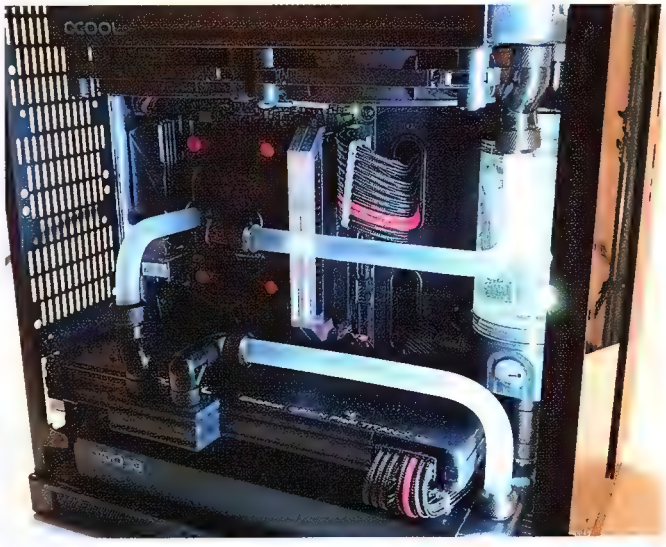
8 FITTINGS WITH STYLE

This is what we were talking about. You can see we've used a rotary S-fitting (acting as two 90-degree fittings) to connect a 90-degree length of tubing from the GPU to the CPU block. This way, we can keep the tubing looking clean, straight into the GPU block, without harming the overall aesthetics. The other 90-degree line coming out of the GPU is a combination of two 90-degree fittings, followed by a length of tubing with a 90-degree bend, which goes down into the radiator below. This allows the coolant to pass into the rad, then up through a male-to-male rotary connector and two extensions, which then go into the reservoir. The smart thing about having those rotary extension fittings below the reservoir is that we can rotate the res, without losing compression on the rubber o-rings, which lets us test other tubing runs without unscrewing the reservoir entirely.



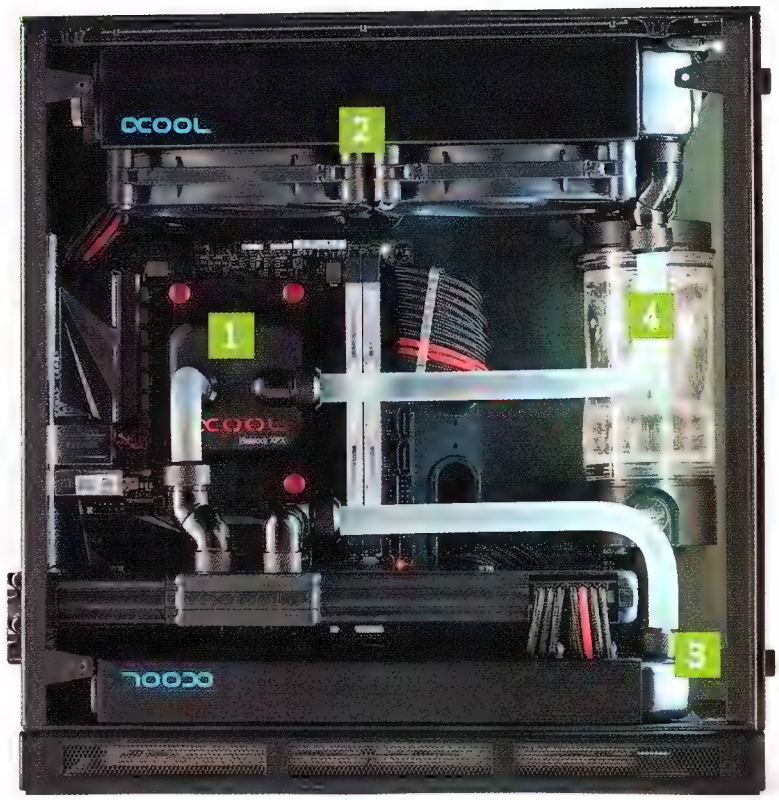
9 THE LITTLE DETAILS

The smallest parts in a liquid-cooled build are the most difficult to work with. This little length of tubing, connecting the pump to the pass-through and into the radiator, took us 45 minutes to get right, perpetually sanding and shortening it to get it to fit correctly. Even then, we realised the pass-through itself needed to be moved ever so slightly to the left, purely to keep the tubing run straight and level. That's not an absolute necessity, more of an aesthetic design decision, if anything. But because aluminium is so soft to work with, as metals go, it's easy enough to take a needle file to it, and just shift the pass-through ever so slightly to perfect the tubing run. On top of that, the smaller you go, the more troublesome it becomes to secure the compression fitting tops, because you start running out of space.



10 PRIMING UP

Decisions, decisions. Once all our tubing runs were complete, there was one last decision to make: coolant colour. We decided to go with the Mayhems Clear X1 as opposed to the UV Black we also had, because the frosted tubing Alphacool sent us looked so sexy on its own. Running black coolant through it would take away some of the aesthetic love. That, however, was the least of our worries, because we had to fill and prime the loop first, which is a daunting task with even a simple loop, never mind ours. For this rig, we had to tip the entire system sideways, unscrew the cap on the side of the reservoir facing upward, then partially fill the res as high as we could, screw the cap back on, turn it back up, power cycle the pump until the res was empty, then repeat until done.



1 The CPU block is a combination of the standard acetal variant plus a modding kit, which provides us with the red thumbscrew tops and the red Alphacool LED logo in the middle.

2 For aesthetic reasons, this build is running in a negative pressure configuration, which means more cleaning for the lucky end user.

3 A bit of sandpaper and a needle file could reduce the height of the angle on this length of tubing by just enough to straighten it up a touch.

4 Replacing the tubing length should allow us to get better access to that reservoir top, meaning easier filling, and a nicer-looking rig.

Waterworks

That's it, then. We're done, wrapped up, finished. Or are we? No. There's plenty more to do. We ended up taking three days to build this rig. Even with the help of pro-modder (and Alphacool's marketing rep) Dave Alcock, it took nearly twice as long as we expected. And there are still erroneous parts and little niggles to tweak to make this rig really shine.

First on the block are those Alphacool radiators. There are two annoyances here: the bottom radiator's logo is upside down, and the logos are blue. To get around this, we're going to get some red vinyl Alphacool labels printed up, which we can overlay on them.

Next on the list is the memory. In the end, HyperX couldn't get the kit we wanted to us in time. No one's at fault, as it was down to an erroneous shipping delay handled by a third-party courier. Because of that, we had no choice but to lean on 16GB (2x 8GB) of Corsair's Dominator Platinum DDR4 @ 3,200MT/s for this build, fitted with a couple of lightbar upgrades. But again, silver and white doesn't match our build, and that spec isn't the 32GB we'd hoped for, so a quick pitch to Corsair may be in the pipeline. To cure the silver and white bars on top, CableMod sells a black variant of the lightbar upgrade kit, with a red LED strip in the middle, too, so that should help smarten up the interior a little.

There's a lot we can do with the cable management in the back, too, as we were up against the wire here, so that's going to be addressed almost immediately. We've also got to find a plan for our simple six-way XSPC fan controller. And the magnetic LED strip we've hidden in the front corner of the chassis needs a stronger form of adhesive, Velcro perhaps, as the aluminium support bar isn't magnetic.

Lastly, there are some loop tweaks we could do. There's not a lot we'd change here; perhaps sand down the radiator end of the GPU tube, to bring the angle down a touch, and work on a fancier length of frosted tubing to connect the CPU and the top radiator together, perhaps consisting of two 90-degree bends, and reducing our reliance on fittings.

All that aside, and the frustration, delays, and massive effort involved from everyone on the team, we're immensely proud of this build. It's cool, quiet, and lovely to look at, even with its flaws. It performs like a trouper, and absolutely kicks butt. There'll be more of this beauty (hopefully with all the tweaks) in a later issue, including the final desk build and peripheral setup, so keep an eye out!

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	2,178	1,832 (-16%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	3,136	3,554 (13%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	2,126	2,312 (9%)
RISE OF THE TOMB RAIDER (AVG FPS)	68	72 (6%)
TOTAL WAR: WARHAMMER II (AVG FPS)	42	43 (2%)
TOM CLANCY'S GHOST RECON WILDLANDS (AVG FPS)	38	38 (0%)
3DMARK: FIRE STRIKE (INDEX)	6,988	7,049 (1%)

Our *APC* Labs Test PC consists of an Intel Core i9-7900X, 32GB G.Skill Ripjaws V Series DDR4 @ 3,000MT/s, an MSI GeForce GTX 1080 Ti Gaming X, and a 512GB Samsung 960 Pro PCIe SSD. All tests performed at 4K at the highest graphical profile.

DIY retro emulator with an RPi and classic Xbox pad

Let's make a fully self-contained emulation machine out of old bits of kit, a spare Xbox controller and a Raspberry Pi Zero!

The Raspberry Pi Zero is tiny, ridiculously tiny. It's also small enough to be hidden in a variety of household objects to enhance their capabilities. Whatever you can find to fit it in, you can turn into some kind of smart machine.

Take old game controllers. If you're anything like us you've probably got a couple of boxes full of old computer equipment you just can't bear to throw away – an Atari Jaguar that hasn't been touched since the '90s, a Sega Dreamcast which you're sure you'll plug in again one day, an old Xbox that lies languishing since you picked up something bigger and better. Turns out it actually was useful to keep them around – it's time to bring these old systems back to life.

We're going to show you how to gut an old videogames controller, replace its innards with a Raspberry Pi Zero, then load it up with a treasure trove of retro games. From start to finish, this project should take you under an hour to complete – and then you'll be able to load up the ROMs you legally own on your new console and enjoy them from the comfort of your sofa.

1 GATHER YOUR EQUIPMENT

While the Zero doesn't take up much space, videogame controllers are often stuffed full of delicate electronics. The trick here is to find a games controller which has enough space inside for the Zero. We're going to be using the original Xbox controller, nicknamed The Duke. If you don't have one to hand, they can be picked up for about $10 from most second-hand electronics shops, and they're easily found online too.

If you can't find one, you can use newer USB game pads that are designed to look like controllers for classic systems like the SNES and Mega Drive. Make sure you choose a controller that has enough buttons for the games you want to play — some classic fighting games, for example, really can't be played on a two-button NES controller.

> "If you can't find one, you can use newer USB game pads that are designed to look like controllers for classic systems like the SNES and Mega Drive."

2 WARNING

Working with electrical items and sharp objects can be dangerous. You risk damaging yourself or, worse, breaking your toys. Please ensure everything is unplugged from electrical supplies before attempting this project. As with any electronics projects, you should also take care to fully ground yourself before playing around with sensitive components — the static electricity from your body can ruin them. Anti-static wrist straps or a few taps on a radiator should do the trick.

You can mod your controller with just a few simple tools

Be careful that you don't lose any small parts when opening up the controller

3 THE BUILD

You should be now have a reasonably good idea of the controller that we'll be working with. 'The Duke' has dual joysticks, six buttons, a D-Pad and two triggers, and it's compatible with most retro games systems.

4 FITTING

If you're using a different controller, double check that the Pi is likely to fit inside before you crack it open. As you'll see here, the Pi nestles neatly between the triggers of this controller — the original Xbox controller is one of the largest.

5 UNSCREWING

The controller is held together by half a dozen cross-head screws. Be careful when opening the case as the buttons and rubber contacts are loose within the controller — they will spill everywhere!

6 OPENING

With the shell removed, you should be able to undo the screws holding the main circuit board in place. Gently unclip the connectors powering the vibration motors in order to completely remove the board. You might find it easier to use pliers for this — just be very gentle as you pull!

7 GENTLY DOES IT

You can see for yourself just how well the Pi fits here; it can be squeezed under the memory card slot. If you want to hold it firmly in place, use some BluTak as a temporary solution. Also, if you're using an older controller, it's worth giving it a bit of a clean. Remove the rubber contacts and gently swab under them using the isopropyl alcohol swabs.

8 CUT TO FIT

Depending on the model of controller, you may find that the Pi blocks one of the internal plastic struts. The plastic is soft enough that a craft knife will easily cut it down to size, though. Start with small strokes, shaving off a tiny bit at a time until you have enough room. Make sure the plastic dust is cleaned out before you reassemble the controller. If you have a can of compressed air, you can use it to easily blow away the shavings.

9 CONNECTING IT UP

If you're using a controller that has a regular USB port on it, you can just plug it into the Pi via a USB OTG converter. If you're using the original Xbox Controller, it's slightly tricky. Microsoft, in its infinite wisdom, has decided that the original Xbox should use USB, but with an incompatible plug design. This means, in order to connect the controller to the Pi, we need to do some wire stripping. Fun!

The wiring inside the Xbox controller's cable uses bog-standard USB wiring colours, so once you've chopped the plugs off the controller and the OTG cable, it's pretty straightforward to connect them together.

The older USB 1.0 and 2.0 cables have fewer wires than the newer 3.0: here's a quick guide

Red
The red wire is one of two handling power. This one is a 5V power line that provides voltage to the circuit

White
This wire is one of two used for differential data signals. This white wire is the positive component and the green wire is the negative one

Green
The circuit can get the difference between the two data signals rather than between a single wire and ground. It's a more effective transmission

Black
This is the other wire associated with the power — the ground wire, which is the counterpart to the 5V wire

Yellow
USB mini/micro cables will also have an additional wire that isn't required for our particular project

10 **WIRING**

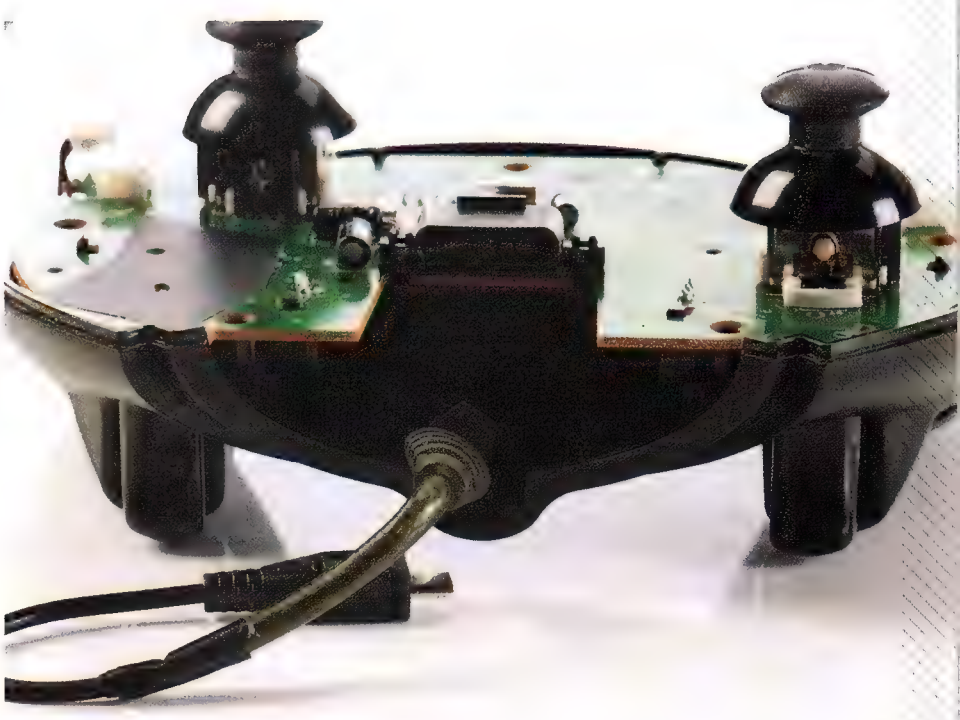
Strip the wires by a couple of centimetres and then connect them together. You should have Red, Green, White, and Black. The Xbox cable also has a Yellow wire which you can ignore. It is worth noting at this point that you need to be sure that you have a USB data transfer cable and not just a plain old power cable — the former will look like the photo on the right, but power cables will be missing the two data wires.

With the wires stripped, we temporarily used regular sticky-tape to make the connections between the OTG cable and the controller — for a more permanent installation, you can use electrical tape or simply solder the wires together.

11 **INSULATION**

One thing to note: you'll need to insulate the bottom of the Pi against all the contacts on the controller. For this quick hack, we've used some of the cardboard packaging — but any non-conductive material will do.

From there, it's as simple as screwing the case back together. Make sure that the controller's buttons and joysticks don't slip out of alignment. Keep track of which coloured buttons go where and you should be fine.



You can solder the OTG cable and controller together, but sticky-tape will also do the trick

"If your TV has a USB socket, you could use that to supply the Pi with power – just make sure it's powerful enough."

12 **WIRING UP**

The Pi will need three wires connected to it in order to work. The controller cable needs to be connected to the USB OTG port. An HDMI cable goes from your TV to the mini HDMI port on the Pi. Finally, a 2A micro USB power supply needs to be plugged into the Pi's power socket. We've used a standard mobile phone charger, but you can use a USB battery pack if you want to reduce the number of wires trailing around your room.

13 **A WORD ABOUT POWER**

You might be wondering whether it's possible to get the HDMI cable to supply power from the TV to the controller. Sadly, the HDMI specification doesn't permit power to flow in that direction. If your TV has a USB socket on it, you could use that to supply the Pi with power — just make sure the socket itself is powerful enough. The Pi needs at least 1 Amp, and ideally 2 Amps. Many TVs will only output 500mA which isn't enough to run the Pi.

14 **LET'S PLAY!**

OK, it's looking good — you're nearly ready to play. The next step is to get some emulation software on this thing.

Installing the RetroPie emulator

It's not as difficult as you might think to run retro software through an emulator.

Right, so you've managed to get your Pi safely ensconced in a controller and all wired up; all you need now are some videogames to play.

For this section of the tutorial we're going to be using the RetroPie emulator. By the end of this tutorial, you'll be able to play a number of games directly from your Raspberry Pi, provided that you legally own the ROM files, of course.

The whole process is as easy as installing the software onto your SD card and then copying across any games that you want to play. If you've already got Raspian installed on your Pi, you can install RetroPie alongside it, or you can dedicate the whole disk to the software if you'd rather.

INSTALL RETROPIE INSIDE RASPBIAN

1 If you've already started using your Pi and want to add RetroPie to it, you'll need to install the software from GitHub. The latest instructions can be found at **github.com/RetroPie/RetroPie-Setup**.

Open up a terminal on your Pi (for example, by SSHing into it from another machine, or by logging in directly to the Pi). Update your repositories and make sure the latest version of the Git software is installed:

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install git
```

Download the latest version of the RetroPie setup script:

```
git clone --depth=1 https://github.com/RetroPie/RetroPie-Setup.git
```

If you're security-conscious, it's a good idea to check what the script does before running it. Once you're ready, you can install it by changing into the correct directory and executing the script:

```
cd RetroPie-Setup
sudo ./retropie_setup.sh
```

The script will take several minutes to run, depending on your internet speed. It may also ask you for permission to install extra software that is needed – you should allow this. Once fully installed, you will need to reboot your Pi:

```
sudo reboot
```

RetroPie can now be run by typing emulationstation. We'll come on to configuring your setup in just a moment.

INSTALL RETROPIE ONTO A BLANK SD CARD

2 If you want your Raspberry Pi Zero to be used solely as a RetroPie machine, this is the choice for you. Be warned: it will completely wipe a microSD card, so if you've got a used one, make sure you back up any important data before starting.

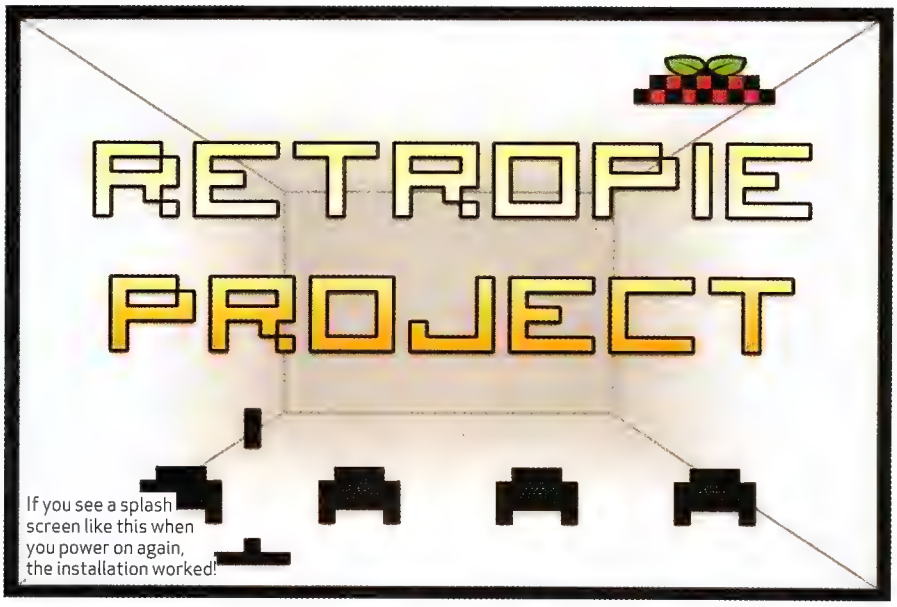
Download the latest version of the software from **blog.petrockblock.com/retropie/retropie-downloads**. Make sure you download the correct SD card image for your machine – the image for the Raspberry Pi 2 is not compatible with the Raspberry Pi Zero. Download the Standard version (not the BerryBoot version). The download is an 800MB .gz file. Unzip it and extract the .img file, which will be around 2.6GB.

You'll now need to write this image file onto your microSD card. This is done in the same way that you would install a normal Raspberry Pi image onto a card. There are slightly different instructions for Linux, Mac and Windows.

What's an emulator?

An emulator is software which lets your computer pretend to be a different sort of computer.

It will allow a Raspberry Pi Zero to run software originally designed for the Sega Mega Drive, or Nintendo N64, old DOS-based PCs, and so on. Emulators aren't without their problems, though. It's nearly impossible to perfectly recreate a games console in software. Keep in mind that older games may have bugs ranging from minor sound and graphical glitches to full-blown crashes.



If you see a splash screen like this when you power on again, the installation worked!

LINUX

3 Use the Disk Manager to select the image file and the microSD card. Follow the on-screen instructions until the image has been fully written to the card.

MAC

4 Download the ApplePi Baker from **www.tweaking4all.com/hardware/raspberry-pi/macosx-apple-pi-baker**. Once you have it installed, you can select the image file and the microSD card. Follow the on-screen instructions.

WINDOWS

5 Download the Win32 DiskImager from **sourceforge.net/projects/win32diskimager**. Once installed, select the image file and the microSD card. Follow the instructions until the image has been written to the card.

CONFIGURING

6 Right, you're almost ready to play. Put the microSD card into the Raspberry Pi Zero, hook up the controller USB cable and the HDMI cable. Finally, plug the Pi into the power. It should boot up automatically and, after a few seconds, you'll be greeted with a configuration screen.

RetroPie should automatically detect any connected USB game pads and step you through setting up the buttons. Once you've finished, you'll be presented with a screen showing all the choices you made.

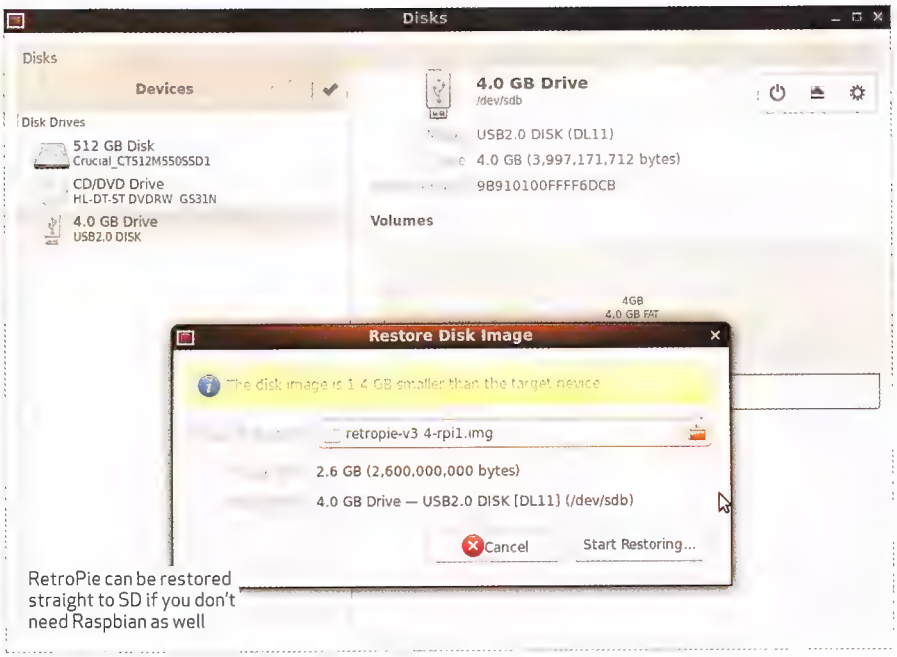
SET UP THE DISK

7 Before we get to playing any games, we need to make sure that RetroPie is able to use all the space on the microSD card. This will allow you to store ROMs and save your games. Select 'RetroPie' from the menu. You'll be presented with several configuration options. Select 'Raspberry Pi Configuration Tool RASPI-CONFIG'.

You can change the default username and password at a later date; for now just use the controller to select 'Expand Filesystem'. Next, highlight the 'Select' button and click on it. After a short delay, you will see a success screen – press OK and you'll be taken to the configuration screen. Press right until 'Finish' is highlighted, then click on it. You should now reboot your Raspberry Pi.

ADDING ROMS

8 The final step is adding new ROMs. Once you've legally purchased and downloaded ROMs from the internet, you'll need to copy them onto the microSD card. ROMs are stored in a separate folder for each system. So, for example, you need to place your Sega Master System ROMs in ~/RetroPie/roms/mastersystem/. Once you've installed ROMs, you're ready to play.



RetroPie can be restored straight to SD if you don't need Raspbian as well

PLAYING

9 Once booted, you'll see a menu with all the available games systems on it. Some emulators will only show up once game ROMs for that system are installed. Scroll until you find the game you want to play, then let rip!

You can always return back to RetroPie if you want to change any of the configuration options, or update the software. And that's all there is to it! Time to sit back and play some games. If you want to find out more about the RetroPie software, visit **blog.petrockblock.com/retropie**.

Where to get ROMs

Many older games have, effectively, been abandoned.

The original publishers are defunct and it's not clear legally who owns the rights. There are several sites which claim to have permission from the original creators to distribute their games, but it's not always easy to tell how legitimate they are. You should ensure that you either buy legitimate copies or download from organisations with the legal right to distribute them.

Make magnificent MIDI music on your Android mobile

Don't just listen to music on your phone, make it! Darren Yates explores the secrets of connecting MIDI devices via USB to your Android phone or tablet.

It's no surprise smartphones killed off MP3 players 10 or so years ago. Even back then, the phone's processing power, storage and headphone socket were enough to make music playback one of the first major roles smartphones nailed on hitting the shelves in 2007/'08. However, as phone hardware and software matured, new apps arrived, turning touchscreens into music keyboards to create your own tunes. Yet, thanks to latency issues, most weren't that satisfying to use, so musicians went back to their Apple Macs, their GarageBand and keyboards, and continued on their merry way. That's unfortunate because Android smartphones now have the horsepower to match PCs on music generation software – they just lack peripheral hardware to make a go of it. But as we'll see, there's a relatively easy fix.

BUY ME A MIDI

If ever there's a Geek's Trivial Pursuit question 'what is the longest-surviving in-use digital interface?', my money is on 'Musical Instrument Digital Interface' or MIDI. It's been kicking around in one form or another since 1982, enabling musicians to hook up keyboards and synthesizers to computers for more than 36 years now. It doesn't convey audio, but rather, controls data indicating which keyboard key was pressed, how fast it was pressed (called 'velocity'), for how long and so on. Using this information, music keyboards could plug into some amazing synthesizers and produce the sound of the 1970s and '80s at will. Even the original Sound Blaster PC sound cards included MIDI within the old DB15 joystick port.

Over the last few years, though, the original 5-pin DIN sockets have given way to USB MIDI – the same MIDI control data but sent over USB – and Bluetooth MIDI – again, MIDI but without the cables. But the really cool thing about MIDI is regardless of the age of a MIDI-capable keyboard, it should still work, although it continues to sit at version 1.0.

MIDI ON ANDROID

Android has officially supported MIDI since the release of Marshmallow 6.0, but unofficially, since Honeycomb 3.1 – that was when Google first incorporated USB-OTG or USB Host mode into the Android OS. Software developers could write their own USB device drivers to enable USB MIDI controllers to hook into an Android device. Yet despite the official support today, Google says it's up to Android device makers to enable MIDI support – it's still considered 'optional'.

So how do you know if your Android device has MIDI support? First up, it needs a USB-OTG port. If it doesn't have that, there's no hope for the rest. However, even if your device has USB-OTG, you could try out the free Check MIDI Support app on Google Play, just to see whether or not your device maker has enabled MIDI support. According to the app, my Moto G5 phone and budget Lenovo Essentials 7 tablet, both of which have USB-OTG, are MIDI-ready. My old LG F70 D315 phone, without USB-OTG, isn't.

HARDWARE REQUIRED

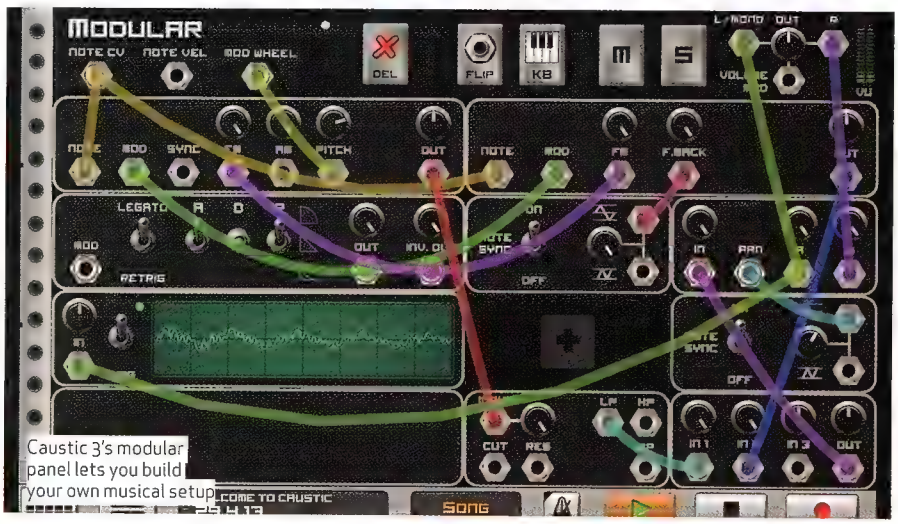
Once you've got USB-OTG sorted, you'll need a USB-OTG cable – you'll find them on eBay for a couple of dollars. It gives you a microUSB plug on one end and a Type-A USB socket on the other.

However, where you go from here depends on the MIDI device you want to hook up. Original-standard MIDI keyboards and sound modules with their 5-pin DIN sockets will need a USB MIDI cable. These sell online for as little as $5, however, since no brand markets its USB MIDI cables as 'Android-compatible', your mileage may vary.

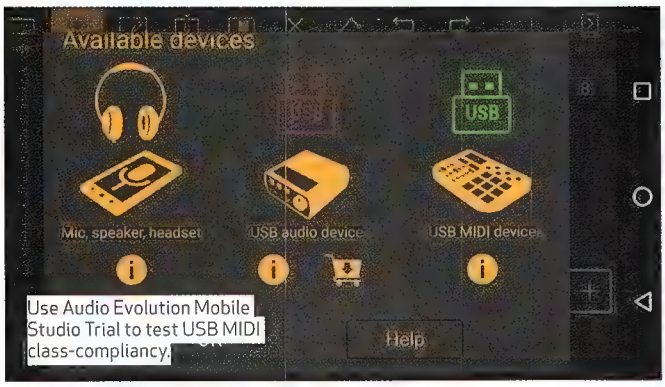
Android requires a USB MIDI cable to be 'class compliant', which means it complies with USB MIDI Class device standards and doesn't need its own device driver software.

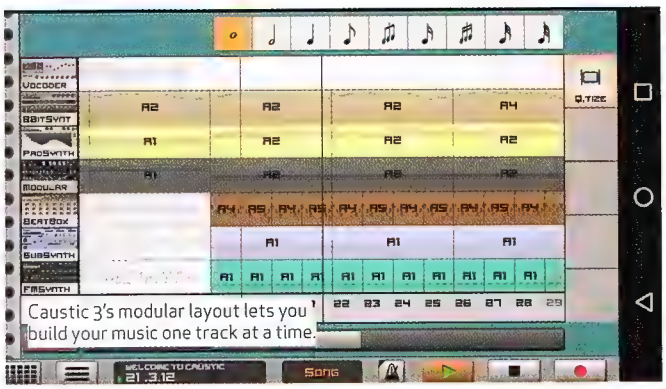
If your music keyboard has its own built-in 'USB to host' interface, it should have a Type-B USB port on the back.

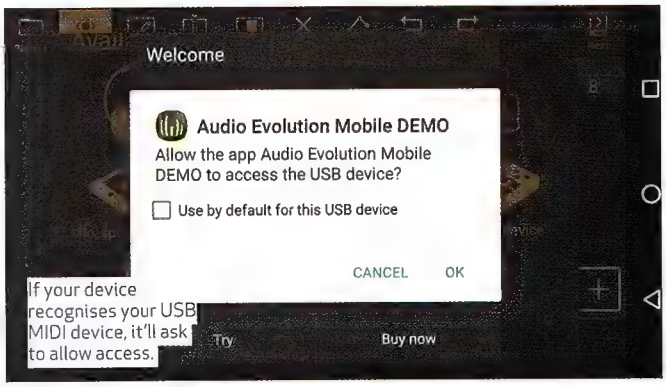
USB MIDI adapters sell for under $20 but Android compatibility can vary.



Caustic 3's modular panel lets you build your own musical setup.






Welcome
Audio Evolution Mobile DEMO
Allow the app Audio Evolution Mobile DEMO to access the USB device?
Use by default for this USB device
CANCEL
OK
If your device recognises your USB MIDI device, it'll ask to allow access.
Try
Buy now

In this case, you just need the USB-OTG cable and a standard USB Type-A to Type-B cable. The USB-OTG cable goes to your Android device and the USB cable connects between the USB-OTG cable and your music keyboard. But again, if the keyboard is not USB Class-compliant, your Android device may not recognise it, so if you're buying a keyboard with this in mind, make sure you thoroughly test out its Android-MIDI skills before you buy.

Aside from all this, however, one area often causing headaches is latency, the time delay for software to register a key has been pressed. Zero latency is hard to achieve, but high-quality apps, good OS MIDI support and a fast Android device CPU can all help.

SOFTWARE

The last step is finding decent apps for your Android device to record your musical genius. If you search Google Play for 'digital audio workstation', you'll find a bucketload of options, but whatever you choose, it must have baked-in MIDI support. Your phone might well be MIDI-ready, but it's still up to the app developer to use it. Not all do.

The three apps we'd consider are n-Track Studio Music DAW, Audio Evolution Mobile Studio and Caustic 3. Give n-Track a go, but beware, you get some features in the free-to-install app, but the full version is a monthly-subscription (up to $2/month), which won't suit everyone. Audio Evolution Mobile Studio will cost you $10, but there's a free trial version. Meanwhile, Caustic 3 is arguably the most potent of the three – it'll also set you back $10, but it's an awesome scrollable stack of 14 machines, from Hammond organ, half a dozen synths of various styles, vocoder (for synthesizing human voices) and more. Give Audio Evolution Mobile Studio a look too – it's an excellent multi-channel audio recorder app that can help produce your final tracks.

NOT JUST A PHONE

The really cool thing about your Android phone is it's not just a phone. Think of it as a portable computer. If it has USB-OTG support, it opens up a world of options you may not have thought of, allowing you to connect up devices as diverse as USB microscopes to peripherals normally designed for PCs such as high-end external USB sound cards. The thing to remember is that unless the peripheral device has its own power, it'll be powered by your phone's battery. That said, most MIDI devices should be low-power enough not to be too much of a problem.

The best news is if you fancy yourself as a musician, you're not just carrying a phone in your pocket, you potentially have a full digital audio workstation. Go nuts.

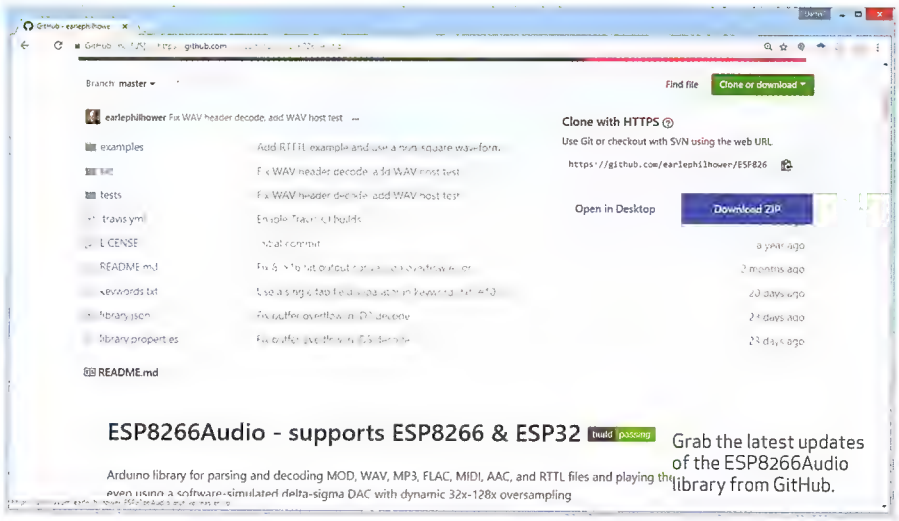
You'll need a USB-OTG cable, whichever MIDI method you use

Yamaha's PSRE363 keyboard, one of many with built-in USB MIDI.

Make a CD-quality digital audio player

The popular ESP8266 Wi-Fi chip is no one-trick pony. Darren Yates uses one in a new high-fidelity 16-bit digital audio player good enough to make your phone think twice.

There's no doubt the Raspberry Pi has been a force for good, renewing global interest in DIY electronics and generally making your own stuff. However, it's important to remember the Pi isn't the only tool in your maker's toolkit. For instance, why spend $60 or so on a Raspberry Pi board to make your own music player, when you can do the same thing with a $5 microcontroller board instead? This month, we're doing exactly that — building a simple digital audio player, but with audio quality that'll give most phones plenty to think about. And in an unusual twist, it uses the ESP8266 Wi-Fi chip, plus the same basic audio tech you'll find in smartphones and PC motherboards.


Branch: master
Find file
Clone or download
Clone with HTTPS
Use Git or checkout with SVN using the web URL
https://github.com/earlephilhower/ESP826
Open in Desktop
Download ZIP
README.md
ESP8266Audio - supports ESP8266 & ESP32
build passing
Arduino library for parsing and decoding MOD, WAV, MP3, FLAC, MIDI, AAC, and RTTL files and playing the
even using a software-simulated delta-sigma DAC with dynamic 32x-128x oversampling

Grab the latest updates of the ESP8266Audio library from GitHub.

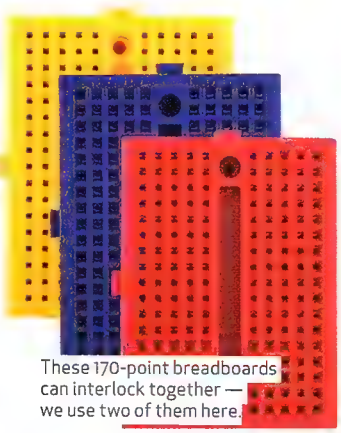
WI-FI CHIP PLAYING AUDIO?

The ESP8266 revolutionised the Internet of Things (IoT) when it hit the market a few years ago, commoditising Wi-Fi to the masses. However, look beyond the headline Wi-Fi functionality and this little microcontroller unit (MCU) is stacked with goodies. For its $5 online price-tag, you get a 32-bit microcontroller running at 80MHz, overclockable to 160MHz, analog-to-digital converter (ADC), plenty of digital I/O pins and up to 4MB of program storage. Alas, as good as it is, the ESP8266 doesn't have any audio outputs to connect to your sound system or headphones, but its 'Inter-Intergrated Sound' interface gives you the next best thing.

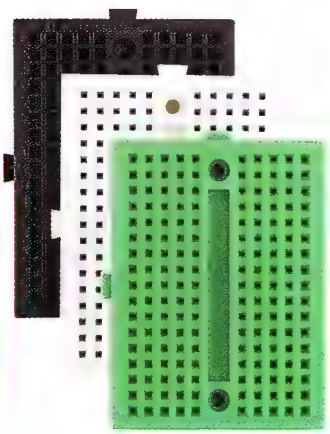
I2S AND SPI

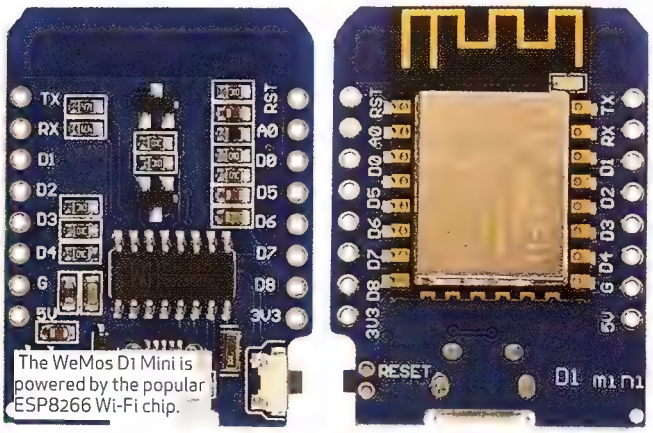
Inter-integrated sound, or 'I2S' for short, is a serial interface designed specifically for shifting around digital audio data — not the analog signal driving your headphones, but the pulse-code modulated (PCM) digital data stored on your flash drive or hard drive. The task of turning that data back into the analog voltage your ears have greater affinity with goes to a device called a 'digital-to-analog converter' or DAC. It outputs the analog voltage equivalent of the digital audio samples that can connect straight to a power amplifier and onto your earphones or speakers. I2S links the device's main processor with the DAC. Think of it as a bit like USB for audio electronics.

While I2S takes care of sending the digital audio samples to the DAC, where do these samples come from? We're using the popular WeMos D1 Mini MCU board that features the

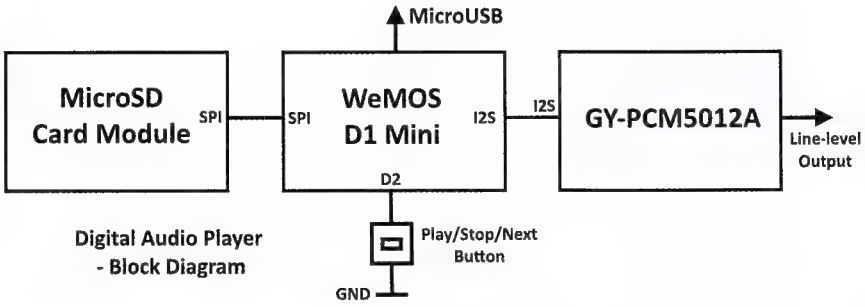


These 170-point breadboards can interlock together — we use two of them here.

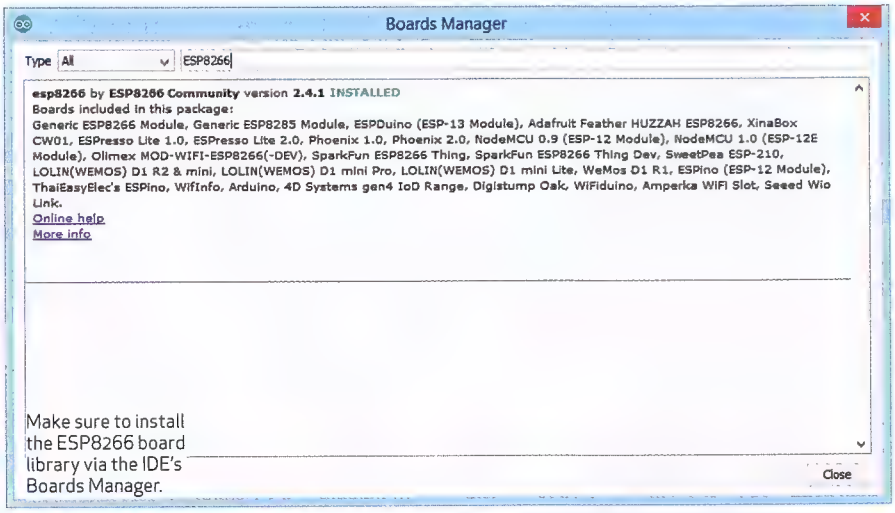




The WeMos D1 Mini is powered by the popular ESP8266 Wi-Fi chip.



The block diagram of our digital audio player.


Boards Manager
Type All
ESP8266
esp8266 by ESP8266 Community version 2.4.1 INSTALLED
Boards included in this package:
Generic ESP8266 Module, Generic ESP8285 Module, ESPDuino (ESP-13 Module), Adafruit Feather HUZZAH ESP8266, XinaBox CW01, ESPresso Lite 1.0, ESPresso Lite 2.0, Phoenix 1.0, Phoenix 2.0, NodeMCU 0.9 (ESP-12 Module), NodeMCU 1.0 (ESP-12E Module), Olimex MOD-WIFI-ESP8266(-DEV), SparkFun ESP8266 Thing, SparkFun ESP8266 Thing Dev, SweetPea ESP-210, LOLIN(WEMOS) D1 R2 & mini, LOLIN(WEMOS) D1 mini Pro, LOLIN(WEMOS) D1 mini Lite, WeMos D1 R1, ESPino (ESP-12 Module), ThaiEasyElec's ESPino, WifInfo, Arduino, 4D Systems gen4 IoD Range, Digistump Oak, WiFiduino, Amperka WiFi Slot, Seeed Wio Link.
Online help
More info
Close

Make sure to install the ESP8266 board library via the IDE's Boards Manager.

ESP8266 chip and 4MB of flash storage – but 4MB won't last long for high-speed digital audio. The simplest and most practical storage is to use a microSD card. Normally, high-performance computing devices will hook up to microSD cards using what's called a 'Secure Digital Input/Output' (SDIO) interface, but unfortunately, few budget MCUs have one of these, and the ESP8266 MCU chip isn't one of them. It does have a Serial Peripheral Interface (SPI) port, though – its not as fast as an SDIO port, but it's a good alternative and fast enough for our needs.

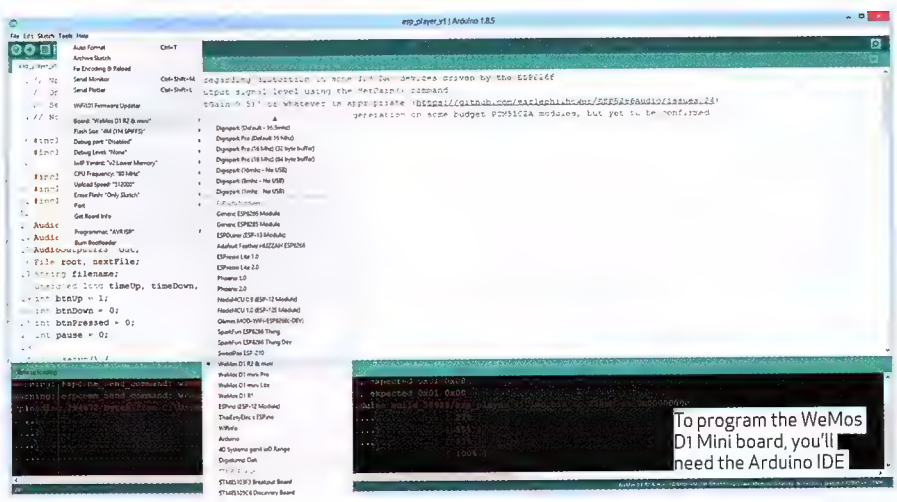
The block diagram should give you a pretty good idea of how this all connects together. Your audio files are stored on a microSD card, which is powered by and connected to the WeMos D1 Mini MCU board via the SPI port connections. That streams the digital audio data into the ESP8266 chip, which then converts it on the fly into I2S format and forwards it onto the DAC. The DAC is also powered by the WeMos D1 Mini board, and since the WeMos D1 Mini is powered via its microUSB port, it means you just need a single USB power source. We control the player by a small momentary-on pushbutton switch connected to the MCU board's D2 I/O pin.

The whole thing is relatively simple, but I2S gives the audio designer some significant advantages, and most of them are to do with audio quality. By using I2S, the DAC's sensitive analog electronic circuitry can be kept away from digital interference generated by the MCU and this physical separation helps the DAC produce a quieter, cleaner audio output. The trick is you need an MCU with I2S support, and the ESP8266 is one of the few budget MCUs that does.

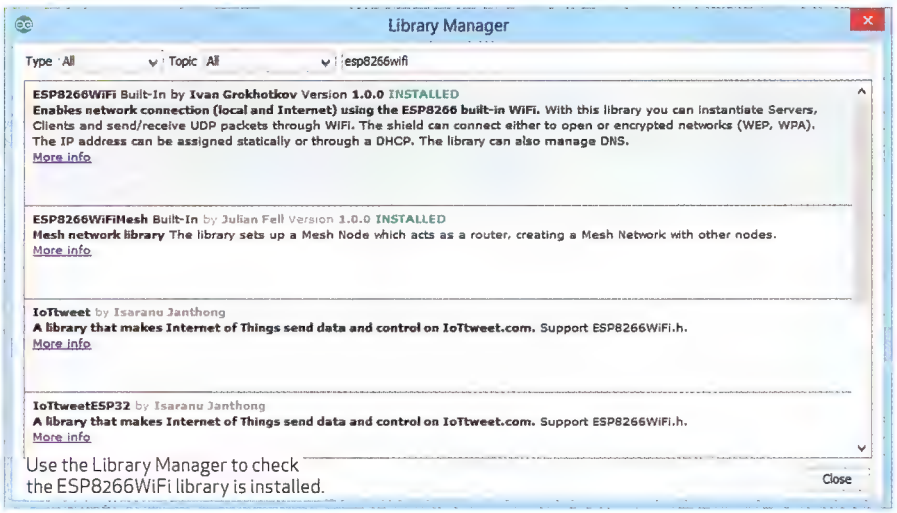
PCM5102A

Many audio enthusiasts will swear by the big money they've spent on their dedicated DAC unit, either connected to their phone or audio source, for generating the highest-quality audio. Yet for all the money you can spend on one, every DAC unit starts with a dedicated DAC chip, and one of the best value options is Texas Instruments' (formerly Burr-Brown's) PCM5102A. It powers many DAC units you'll find online, but you'll also find it on a number of small DIY circuit-board modules on eBay for around $4. The version we're using is called the 'GY-PCM5102A' and only requires six connections to our project. Some online forum posters will tell you the PCM5102A isn't perfect (read up on 'Gibbs Effect' if you want a deep dive into the tech), but we reckon it'll still outgun just about any smartphone, and here's why. The PCM5102A supports sample rates up to an eye-watering 384kHz and plumbs bit depths to 32-bits. It has a solid signal-to-noise ratio (SNR) of 112dB and its total harmonic distortion (THD) is rated better than 0.003%. These are high-class specs, however, with our fairly crude and simple build, we can't quite match them. Still, on my testing, we can achieve 92dB SNR, which is very respectable, particularly given we're

The ESS 9018 DAC inside Gigabyte's Z370 Aorus Gaming 7 motherboard uses I2S.



To program the WeMos D1 Mini board, you'll need the Arduino IDE


Library Manager
Type All
Topic All
esp8266wifi
ESP8266WiFi Built-In by Ivan Grokhotkov Version 1.0.0 INSTALLED
Enables network connection (local and Internet) using the ESP8266 built-in WiFi. With this library you can instantiate Servers, Clients and send/receive UDP packets through WiFi. The shield can connect either to open or encrypted networks (WEP, WPA). The IP address can be assigned statically or through a DHCP. The library can also manage DNS.
More info
ESP8266WiFiMesh Built-In by Julian Fell Version 1.0.0 INSTALLED
Mesh network library The library sets up a Mesh Node which acts as a router, creating a Mesh Network with other nodes.
More info
IoTtweet by Isaranu Janthong
A library that makes Internet of Things send data and control on IoTtweet.com. Support ESP8266WiFi.h.
More info
IoTtweetESP32 by Isaranu Janthong
A library that makes Internet of Things send data and control on IoTtweet.com. Support ESP8266WiFi.h.
More info
Close
Use the Library Manager to check the ESP8266WiFi library is installed.

using no shielded audio cabling whatsoever. Few, if any, smartphones can match those specs.

That said, the PCM5102A is just one of a bucketload of I2S DACs on the market – Cirrus Logic makes the popular CS4334 16-bit stereo DAC and Realtek makes an ALC series of I2S DAC chips. These are the same chipmakers that supply PC motherboard makers such as Gigabyte and ASUS. For example, Gigabyte's top-end Z370 AORUS GAMING 7-OP motherboard features the ESS SABRE 9018 DAC chip – its main data interface is I2S. Some chips come with multiple interfaces, I2S is a long-term standard that's easy to use.

BUILDING THE PROJECT

We've built the whole project on two small 170-point breadboards – these sell on eBay for around $1 or so each. You'll see interlocks on the sides of each breadboard that allow you to join them together. However, despite the fact we're using breadboards, the WeMos D1 Mini and GY-PCM5102A boards require soldering of their header pins to plug into the breadboards. If you don't have soldering skills, now is a good time to get them or rope in a knowledgeable mate. Seriously, learning to solder really is a key skill in making your stuff. As for other components, you'll need some 'dupont' hook-up wires and a two-pin momentary-on pushbutton switch – again, we bought ours from eBay as a pack of 10 for $1 or so. Use the overlay diagram and photo of ours as a guide to building yours.

HOOK-UPS AND POWER-UPS

Powering the player is straightforward – the D1 Mini board drives the whole show, so you just feed in power via microUSB cable. Even though the ESP8266 chip and your microSD card run off 3.3VDC and USB is 5VDC, the D1 Mini board includes a 3.3VDC voltage regulator to keep everything happy. Audio output comes via a standard 3.5mm TRRS (tip-ring-ring-sleeve) socket. However, keep in mind, this is NOT a headphone socket. The player has no volume controls, so think of it as a component CD player and feed the output to a powered audio system with its own volume control. If you need one, you can buy a 3.5mm-to-3.5mm stereo cable from any home entertainment store for under $10.

SOURCE CODE

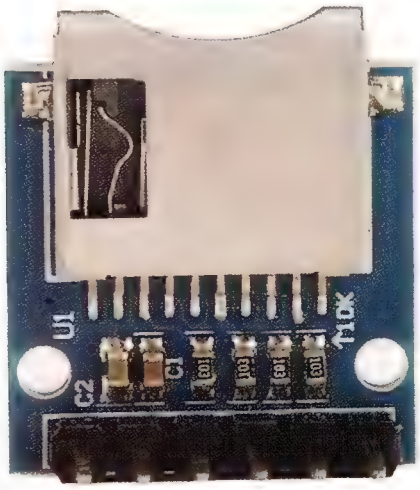
That takes care of the hardware, now for the software. You'll find the source code required in a zip file on our website at **www.apcmag.com/magstuff**. You'll also need the Arduino integrated development environment (IDE), which you can grab from **arduino.cc/downloads**. Install it, launch it. Now from the top menu, select Tools, Board and Boards Manager from the top of the new list. Wait until the platforms index has loaded into the new Boards Manager window and type 'ESP8266' in the search bar. If not installed, install the latest version of the 'esp8266 by ESP8266 Community' board set. When installed, press Close.

Next, go back to the top menu, but this time select Sketch, Include Library, Manage Libraries. When the Library Manager window appears, wait for the library index to load, then at the top right, type 'ESP8266WiFi' into the search bar. Depending on your version of the IDE, this library should be built-in – but if you don't see the green 'INSTALLED' indicator next to the library entry, click on that ESP8266WiFi entry and press the Install button. Finally, press the Close button and close the IDE.

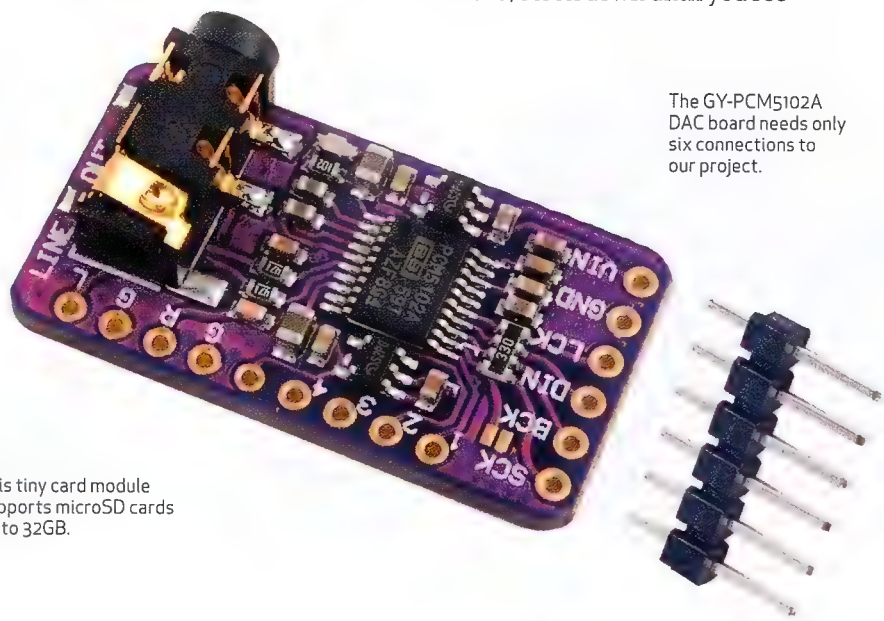
Now unzip the source code pack from our website and copy the contents of the 'libraries' subfolder into the same subfolder of the IDE installation. The library we're using here is the open-source 'ESP8266Audio' library by Earle Philhower III. Once you've copied that across, open up the IDE again, load in the 'esp_player_v1.ino' file and plug your WeMos D1 Mini board into your PC via a suitable cable.

CODING THE ESP8266

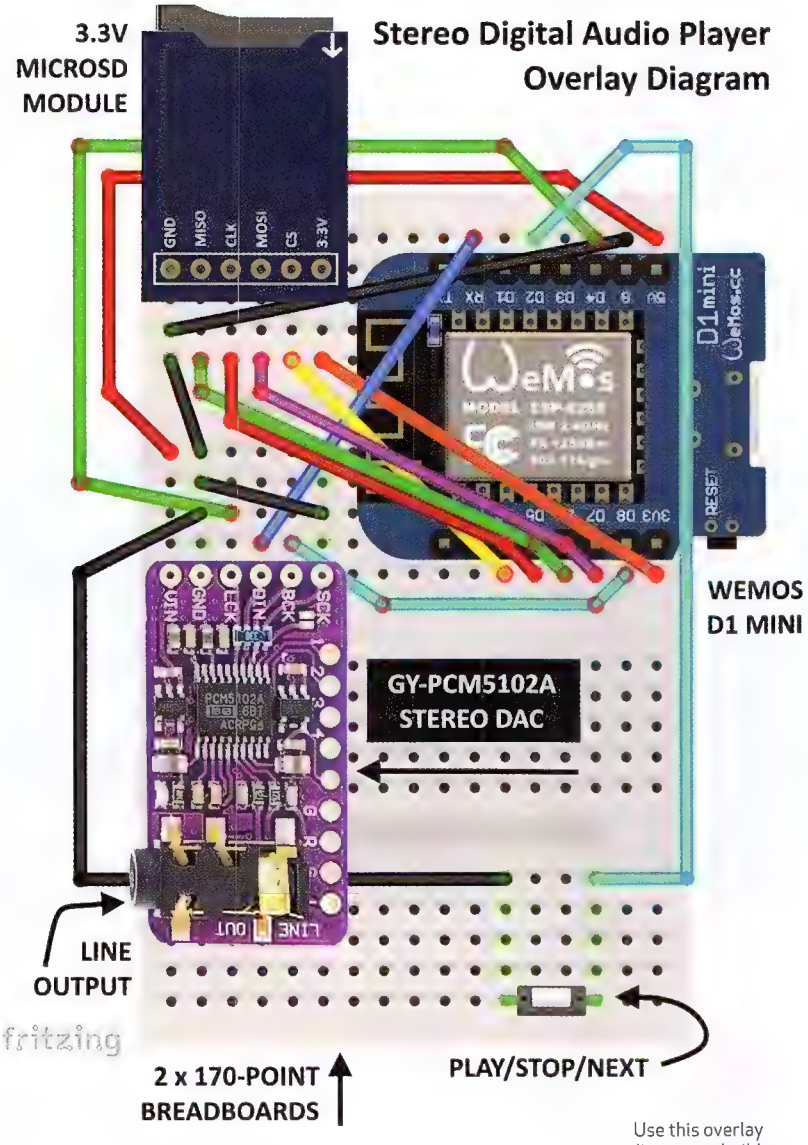
To program the source code into the WeMos D1 Mini's ESP8266 chip, we need to compile it into ESP8266-speak – that's what the Arduino IDE will do. First, from the main menu, select Tools, Board, scroll down until you see



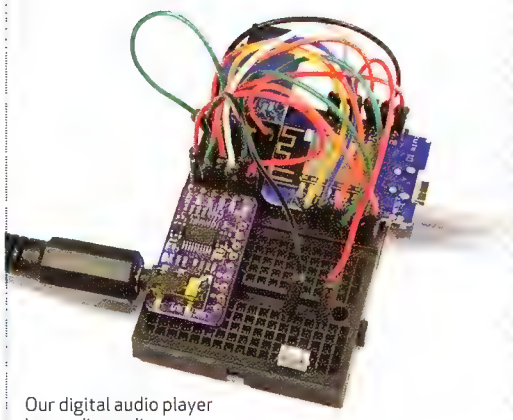
This tiny card module supports microSD cards up to 32GB.



The GY-PCM5102A DAC board needs only six connections to our project.



Use this overlay diagram to build your own digital audio player.



Our digital audio player has audio quality approaching CD-levels.

'WeMos D1, R2 & Mini' and select it. Next, go back to the Tools menu and ensure you set the following:

Flash Size: "4M (1M SPIFFS)"
Debug Port: Disabled
IwIP Variant: v2 Lower Memory
CPU Frequency: 80MHz
Upload Speed: 512000
Erase Flash: Only Sketch
Port: choose which ever is not COM1

When you're ready, press the green right-arrow button top-left on the IDE and the code will automatically compile and upload to the ESP8266. You should see the blue LED on the board flash during upload.

AUDIO FORMAT

The player handles WAV-format 44.1kHz/16-bit stereo audio files – the type you get from ripping audio CDs. Sure, MP3 and AAC files are more convenient, but if you're serious about audio, uncompressed pulse-code modulated (PCM) WAV files are as good as you'll get. The microSD card module will handle cards up to 32GB, which should be near enough to 60 CDs' worth of 44.1kHz/16-bit stereo audio.

HOW THE BUTTON WORKS

To keep the build as simple as possible, we decided to have just a single button do everything we needed. As soon as power is applied, the player will begin playing the first file on the microSD card, provided a card is installed and FAT32-formatted. If you press the button once, it will pause the playback; press it again and it will restart. If you hold it down for more than a second and let go, it will automatically move to the next track. Completion of one audio track will automatically begin playback of the next and once the full play list is complete, playback stops.

LIMITATIONS

The WeMos D1 Mini board has a number of add-on 'shields' to expand functionality and one of those boards is a microSD shield. So, you might be wondering why did we go and use a separate microSD board rather than just use the microSD shield instead? Unfortunately, the WeMos MicroSD shield board is hardwired to use I/O pin D4 for the 'chip select' function. However, that same pin is also hardwired in the ESP8266 chip as the I2S clock pin – since we can't change this and changing the 'CS' pin on the microSD shield is well beyond the simple, we had to use a separate microSD card board that allows us to select our own CS pin.

The other limitation in this first version is that the audio files must exist in the root folder of the microSD card and they have to be in 8.3-character format. We hope to fix this shortly and get it to work with standard Windows filenames. We'll let you know how we go.

MODIFICATIONS

You don't have to operate the audio player using the single pushbutton. That button pulls I/O pin D2 low (digital-0) to activate it, but you can achieve the same thing by using a transistor driven via a 10kohm resistor by some other sensor – light, sound, temperature, take your pick. A common BC547 NPN transistor with a 10kohm resistor connected to its base would be ideal. We'll leave how this works as design homework (although if there's enough interest, we'll cover how to do it in a future masterclass).

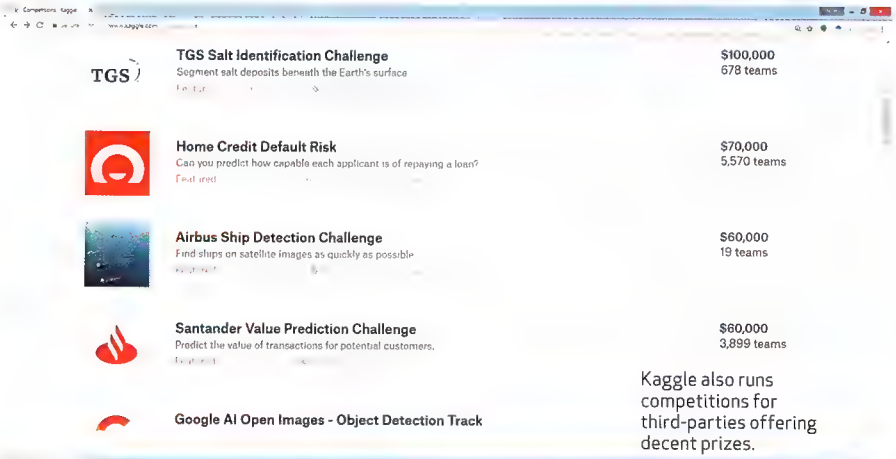
Once you've programmed the source code into the ESP8266 chip on the WeMos D1 Mini board, you can power it with almost anything you like. The total current consumption is approximately 40mA, so you could power it via a USB battery pack, solar panel setup, even your smartphone via USB-OTG cable – basically, anywhere you can get a clean 5VDC voltage with at least 50mA of current output should do nicely. ■

Improving your Kaggle Titanic scores

Understanding your data better can make a big difference to your results. Darren Yates looks at ways to improve classification accuracy scores on Kaggle's Titanic competition.

Last month, we introduced you to Kaggle, the Australian-created website for data scientists and machine-learning enthusiasts alike to learn, play and solve global problems with data via the site's many competitions. We launched into the 'Titanic: Machine Learning from Disaster' competition as a great way to take baby steps into the world of machine-learning. The task is to try and predict from their various attributes, which of a group of passengers survived the ill-fated ship's maiden voyage. Our initial run-through last time got us started with Kaggle and, in particular, using its online 'notebook' machine-learning code editor. We built our first model and submitted our results to the Titanic competition, achieving a score of 0.69856 (out of 1.0), which placed us in 9,772nd position out of 10,449 entries. This month, we're looking to improve the model's classification accuracy and move up that leaderboard a bit!

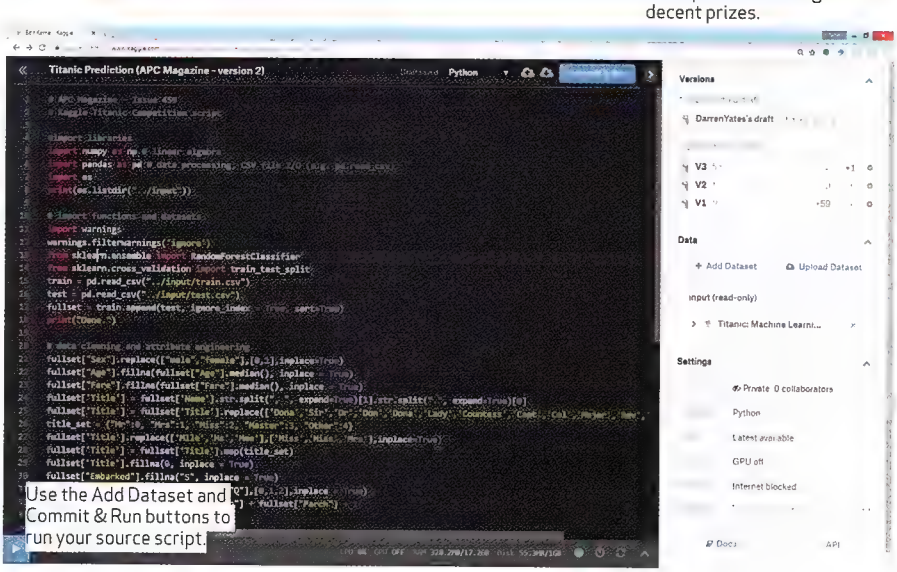
Titanic Prediction (APC Magazine - version 2)
Python
Console
The code for data cleaning and attribute engineering isn't too complicated.


TGS Salt Identification Challenge
Segment salt deposits beneath the Earth's surface
$100,000
678 teams
Home Credit Default Risk
Can you predict how capable each applicant is of repaying a loan?
$70,000
5,570 teams
Airbus Ship Detection Challenge
Find ships on satellite images as quickly as possible
$60,000
19 teams
Santander Value Prediction Challenge
Predict the value of transactions for potential customers.
$60,000
3,899 teams
Google AI Open Images - Object Detection Track
Kaggle also runs competitions for third-parties offering decent prizes.

THINKING IN DATA

The Titanic competition leaderboard is a continually moving target constantly updated with new entries, but even so, a score of 0.69856 and 9,772nd position isn't far off the 'wooden spoon' award. Still, our first model was a pretty simple affair – we built a single decision tree classifier using just the passengers' age and gender to determine whether or not they survived. If you remember, we said previously that tossing a coin will get you 50% accuracy (0.5), so a score of 0.69856 is a fair improvement, but being in 9,772nd position shows we have many other entries ahead of us on the leaderboard.

The Titanic dataset is basically a two-page spreadsheet – one partition contains the 891 passengers of the 'train' dataset and a second part called the 'test' dataset has another 418 passengers. Over 2,200 passengers were on the ship when it sank, so these two datasets account for a little more than half of passenger numbers. The difference between the two sets is that



we know the outcomes of the 891 passengers in the train dataset; we're not told how the passengers fared in the 'test' dataset, although the Kaggle team knows the outcome. Our job is to learn a set of rules or 'model' from the 'train' dataset that we can then apply to predict the fate of the passengers in the 'test' set. Both the 'train' and 'test' dataset partitions contain 11 features or 'attributes' of each passenger:

PassengerId — the identifier of the passenger

Pclass — the class of fare purchased by the passenger

Name — the passenger's name

Sex — the passenger's gender

Age — the passenger's age

SibSp — the number of siblings or spouses also on board

Parch — the number of parents or children also on board

Ticket — the passenger's fare ticket number

Fare — the price paid for travel

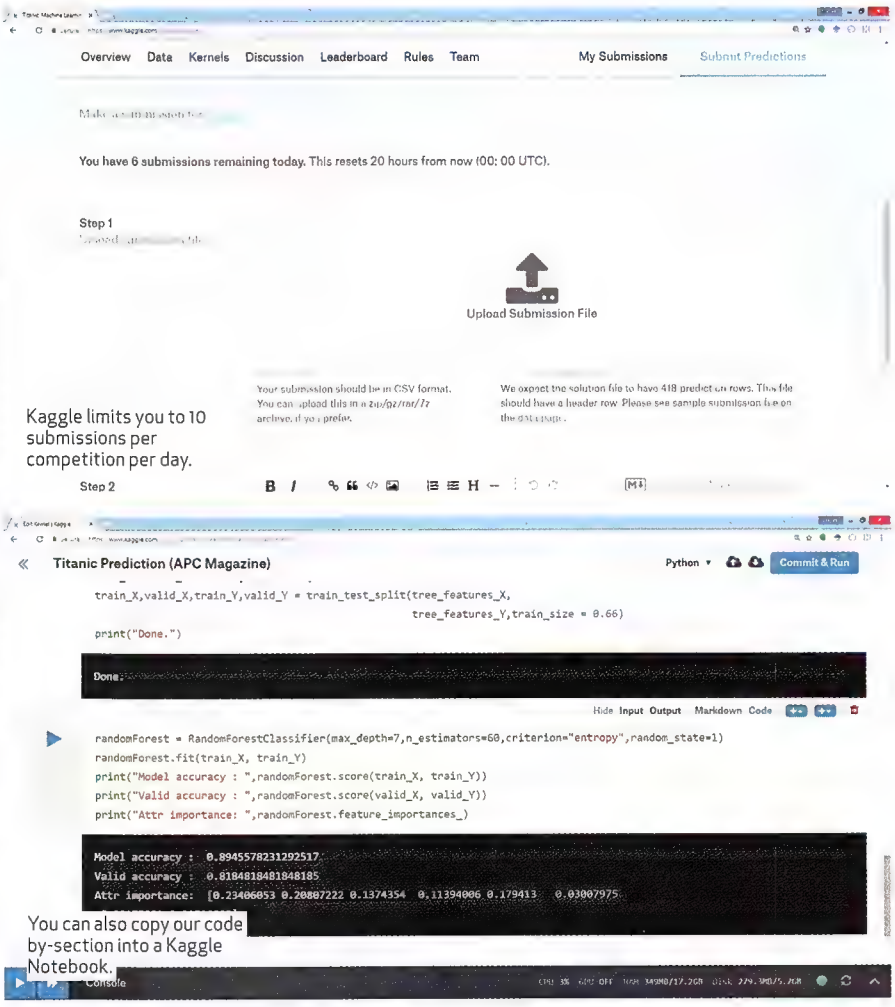
Cabin — the passenger's cabin number

Embarked — location at which the passenger boarded

The 'train' dataset has a 12th attribute called 'survived' — whether the passenger survived (1) or not (0).

History tells us those rescued were predominantly women and children, so basing our initial decision tree classifier using the 'sex' and 'age' attributes of the passengers wasn't a silly idea. However, given we only scored 0.69856 shows these two attributes alone don't tell the full story.

Kaggle allows users to publish their models — what Kaggle calls 'kernels' — along with explanations on why certain options were chosen. There are some very generous 'Kagglers' who have offered some brilliant explorations, backed up by statistical modelling — we've made a small list of some must-read kernels at the end of this article. The ideas we've used here commonly feature on Kaggle and give you a guide of how to go about improving classification accuracy.



Kaggle limits you to 10 submissions per competition per day.

You can also copy our code by-section into a Kaggle Notebook.

DATA CLEANING

A common problem you'll face with many real-world datasets is that of missing data. It's a problem because machine-learning algorithms tend not to work well with what they can't see. For starters, both the 'train' and 'test' datasets have records missing values for the 'Age' attribute — 177 in the training set, 86 in the test set. Last time, we raced through this and simply used Python's fillna() function to fill missing Age attribute values with 'zero'. It's simple, but not necessarily the best move, since we're effectively changing the distribution of passengers by adding 263 newborns.

Another option we could've taken is to simply delete the records with missing data, but that's a sledgehammer approach (we also can't do this with the 'test' dataset, otherwise our submission results will be incomplete). A more reasoned approach is to calculate or 'impute' the passenger's age from other passengers who share the same gender and ticket class ('Pclass') and taking an average age from those passengers. However, the easiest solution is to use the median — the age value of the middle record when ordered from lowest to highest. The median can also be used to fill in the one 'Fare' record value missing.

ATTRIBUTE SELECTION

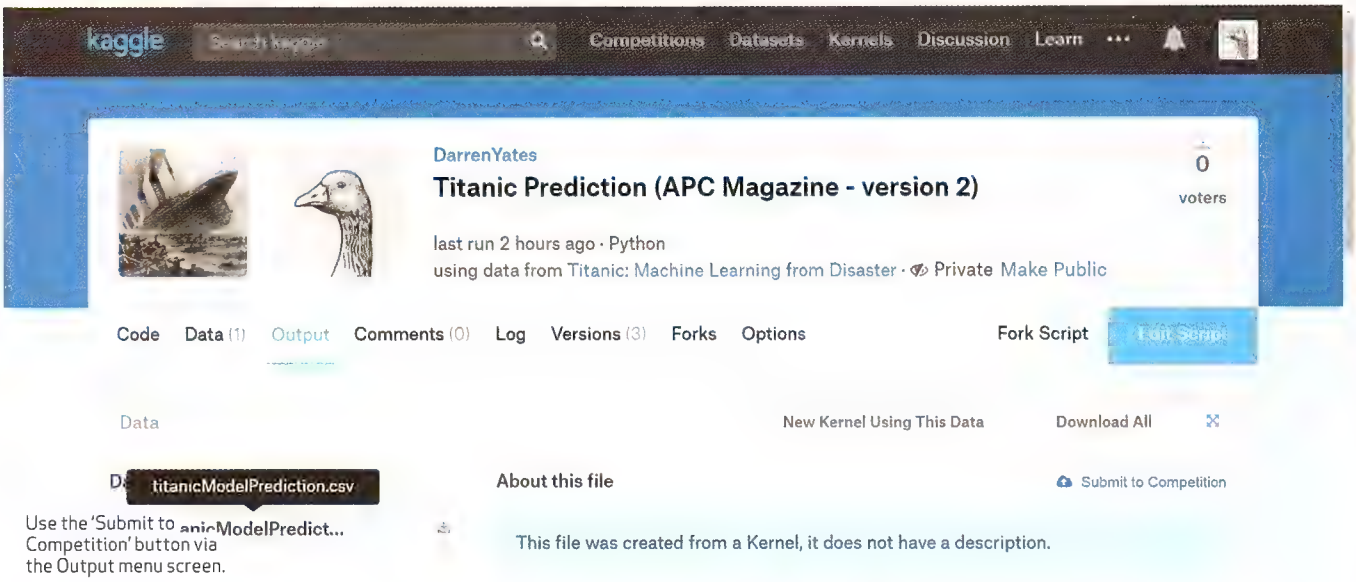
As we've said, we used only two attributes last time — 'sex' and 'age', yet there are 11 attributes available to us. One thing we could do straightaway is simply add in the other attributes and create a new model — after all, the more data we can use, the better our model, right? Well, actually, no — not always. Of the 11 attributes in the 'train' dataset, 'Cabin' is missing 687 out of 891 values — there's no point in trying to guess them. Also, the 'Passenger ID' attribute will be unique for every passenger — there's no way to categorise them, so they're of little use, too. The 'Ticket' attribute similarly looks random, so it's of no obvious help. The 'Name' attribute at first glance appears similar to 'Passenger ID' in that every passenger has a different name, so there's no obvious way to group them. But that's not strictly true and we'll revisit this attribute shortly.

For now, that leaves us with seven attributes — Pclass, Sex, Age, SibSp, Parch, Fare and Embarked.

What we can do now is build a new model from these seven attributes, submit the results to Kaggle and see how we go. This we did and our score improved to 0.71770, but this only moved us up from 9,772nd to 9,604th position. Clearly, there's more to do.

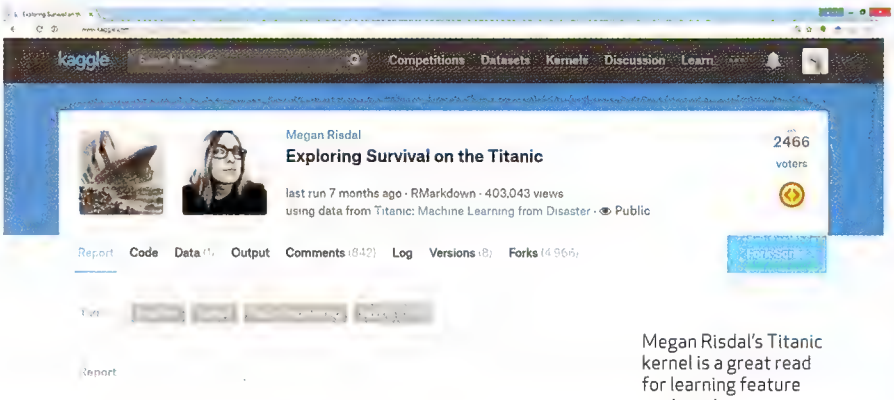
ATTRIBUTE ENGINEERING

Remember the 'Name' attribute? While every passenger obviously has one, each name value also hides information we can group on. For starters, it hides the title of each passenger. The vast majority have standard titles of 'Mr', 'Mrs', 'Miss' or 'Master', but there are also rarer titles such as 'Sir', 'Dr', 'Countess' and so on. To get better access to this data, we can create or 'engineer' a new attribute

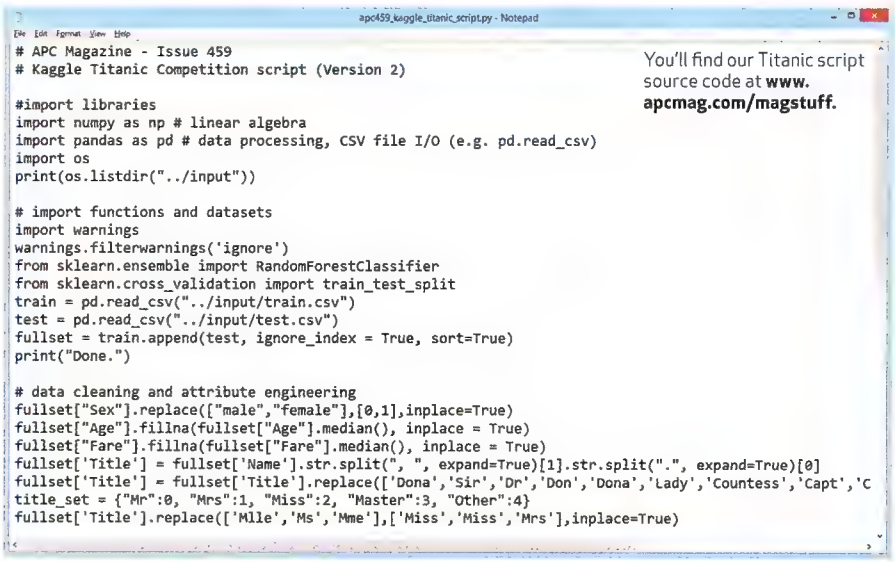


Use the 'Submit to Competition' button via the Output menu screen.

"Decision tree algorithms are great for machine-learning for many reasons, but one of the main ones is that they're easy to use."



Megan Risdal's Titanic kernel is a great read for learning feature engineering.


apc459_kaggle_titanic_script.py - Notepad
File Edit Format View Help
APC Magazine - Issue 459
Kaggle Titanic Competition script (Version 2)
#import libraries
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import os
print(os.listdir("../input"))
# import functions and datasets
import warnings
warnings.filterwarnings('ignore')
from sklearn.ensemble import RandomForestClassifier
from sklearn.cross_validation import train_test_split
train = pd.read_csv("../input/train.csv")
test = pd.read_csv("../input/test.csv")
fullset = train.append(test, ignore_index = True, sort=True)
print("Done.")
# data cleaning and attribute engineering
fullset["Sex"].replace(["male","female"],[0,1],inplace=True)
fullset["Age"].fillna(fullset["Age"].median(), inplace = True)
fullset["Fare"].fillna(fullset["Fare"].median(), inplace = True)
fullset['Title'] = fullset['Name'].str.split(", ", expand=True)[1].str.split(".", expand=True)[0]
fullset['Title'] = fullset['Title'].replace(['Dona','Sir','Dr','Don','Dona','Lady','Countess','Capt','C
title_set = {"Mr":0, "Mrs":1, "Miss":2, "Master":3, "Other":4}
fullset['Title'].replace(['Mlle','Ms','Mme'],['Miss','Miss','Mrs'],inplace=True)

You'll find our Titanic script source code at **www.apcmag.com/magstuff.**

called 'Title' that builds five categories – one each for 'Mr', 'Mrs', 'Miss' and 'Master', plus another for the 'rare' titles.

We use Python's string split function to split off the left and right sides at particular points of each name value to leave us with just the passenger's title:

```
fullset['Title'] =
fullset['Name'].str.split(", ",
expand=True)[1].str.split(".",
expand=True)[0]
```

The 'data cleaning and attribute engineering' code block in our source code (details below) and the codelines starting with "fullset['Title']" deal with creating this attribute.

The 'SibSp' and 'Parch' attributes tell us the number of siblings and spouses, parents and children each passenger had – from this, we can build another attribute called 'FamilySize', denoting the size of the family the passenger is from. (Again, because of space limitations, we're cutting across how the importance of this data was discovered, read the kernels at the end of this story for more). The codeline for this is:

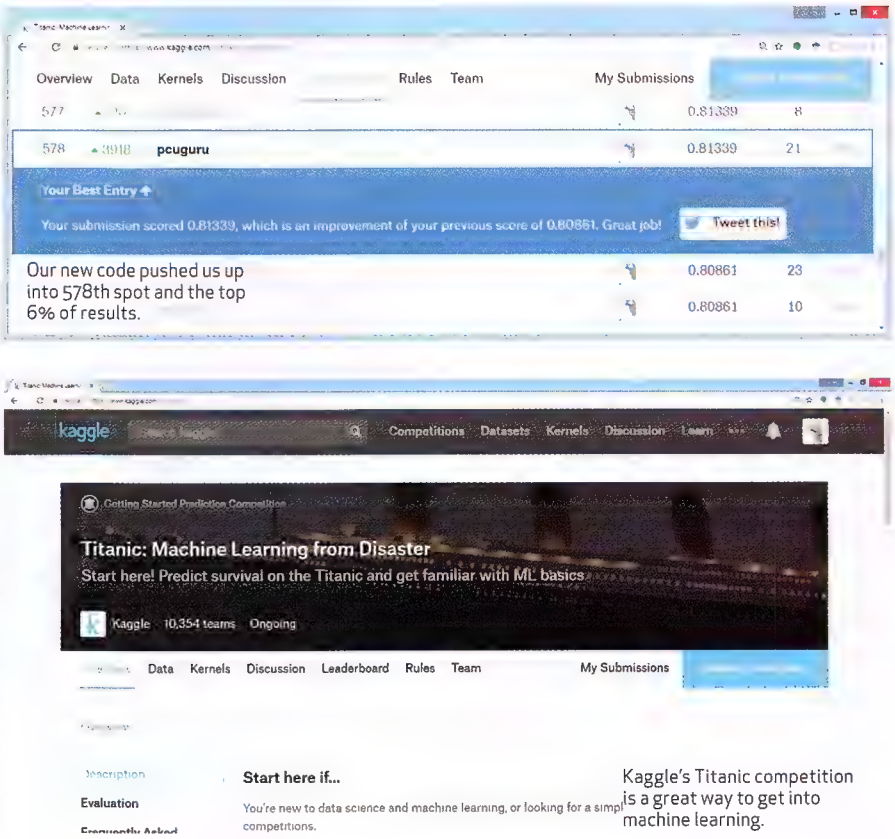
```
fullset["FamilySize"] =
fullset["SibSp"] +
fullset["Parch"] + 1
```

Now we can build another decision tree model, this time, replacing the 'SibSp' and 'Parch' attributes with 'FamilySize' and adding in the 'Title' attribute – that gives us Age, Sex, Pclass, Fare, Title, Embarked and FamilySize. Again, we submitted the results of the model to Kaggle and our accuracy score rose to 0.73205, moving us to 9,388th position.

ONE TREE OR MANY TREES?

Decision tree algorithms are great for machine learning for many reasons, but one of the main ones is that they're easy to use – if you can follow a roadmap, you can generally read a decision tree. The problem, though, is that one decision tree can only represent one view of the data – the dominant view. For other less-dominant but informationally-rich views, one tree isn't enough. We looked briefly a couple of issues ago at the concept of 'decision forests' that combines multiple decision trees together. One of the many algorithms available to Python is 'Random Forest', a brilliant algorithm developed by Leo Breiman in 2001 – it's quite fast, can offer high accuracy and can build a forest of decision trees as large as you need, to cover many different data views. If you're serious about understanding machine learning, this is one of the classification algorithms you should get a decent handle on (we'll look at it in a future masterclass).

By simply replacing the 'decision tree' algorithm with 'random forest' instead, we can broaden our model to consider different possibilities.


Overview Data Kernels Discussion Rules Team My Submissions
577 0.81339 8
578 3918 pcuguru 0.81339 21
Your Best Entry
Your submission scored 0.81339, which is an improvement of your previous score of 0.80861. Great job!
Tweet this!
Our new code pushed us up into 578th spot and the top 6% of results.
0.80861 23
0.80861 10
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Competitions Datasets Kernels Discussion Learn
Getting Started Prediction Competition
Titanic: Machine Learning from Disaster
Start here! Predict survival on the Titanic and get familiar with ML basics
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Data Kernels Discussion Leaderboard Rules Team My Submissions
Description
Evaluation
Frequently Asked
Start here if...
You're new to data science and machine learning, or looking for a simpl
competitions.

Kaggle's Titanic competition is a great way to get into machine learning.

FINAL KAGGLE SUBMISSION

The proof of the power of Random Forest is in its results. Again, we build our model, produce our results and submit them back to Kaggle. This time, however, the combination of attribute engineering and changing from 'decision tree' to 'random forest' has boosted our score from 0.73205 to 0.81339. It might not seem like a huge gain, but in terms of accuracy, it's actually a pretty decent boost. What's more, it hasn't hurt us on the Kaggle leaderboard, either – from 9,388th position, we've rocketed up more than 9,000 paces to 578th spot and sitting inside the top 6% of results.

HOW YOU DO IT

Now that we've explained what we did, for those who missed last month's masterclass, here's a brief 'how to do it yourself'. First, sign up to Kaggle (**www.kaggle.com**) – it's free. Next, across the top menu, select 'Kernels', then click on the white 'New Kernel' button near the top-right of the fresh 'Kernels' page. You'll then be asked to select the kernel type – last month, we selected 'notebook'; this time around, we're going for 'script'. The difference between the two is that a notebook allows you to run your code in sections or 'cells', whereas a 'script' is a top-down complete run-in-one code editor. That suits us more this time.

Once the new Script editor appears, you'll see a 'Data' groupbox on the right side with an 'Add Dataset' button. Press it. On the new 'Add Data Source' window, click on the 'Competitions' menu list and select 'Titanic: Machine Learning from Disaster' – this will load the dataset and eventually bring you back to the editor. Now head over to our website at **www.apcmag.com/magstuff** and download the Titanic competition script file 'titanic_script.zip'. Unzip it and copy the contents of the 'titanic_script.py' file into the script editor. Click at the top left and enter a name for your script, click back in the main text area and the blue 'Commit & Run' button should light up. Press it. It'll grey out while your code executes and the output file is created. When it colours blue again, press the double-left arrow in the top-left of the window. This takes you back to a summary window of your script. Under the header, you'll see a horizontal menu. If your code has executed correctly, you'll see an 'Output' menu option. Click on it. Your output file 'titanicModelPrediction.csv' will appear on the left. To the right, you'll find a 'Submit to Competition' button. Press it once and you'll automatically send that file for scoring. Within a few seconds, you should get your score back. The random selection method we're using for training records means we generate a slightly different model each time it runs. This also varies the resulting dataset file you send back so you may seem some variation in the accuracy result.

One thing to remember – Kaggle allows you 10 submissions per competition per day. If you're on the Australian east coast, that number resets at 10am each morning.

WHAT TO READ

Kaggle allows users to publish their 'kernel' code on the Kaggle.com website. If you're interested to learn more, but a little stuck on where to start, we'd suggest reading through these kernels:

Exploring Survival on the Titanic – **kaggle.com/mrisdal/exploring-survival-on-the-titanic**

A Data Science Framework: To Achieve 99% Accuracy – **kaggle.com/ldfreeman3/a-data-science-framework-to-achieve-99-accuracy**

Titanic Data Science Solutions – **kaggle.com/startupsci/titanic-data-science-solutions**

HAVE A GO

So, there you go. We started this month languishing in the bottom 6% of the Titanic leaderboard at 9,772nd and we finish it inside the top 6% at 578th spot – that'll do. Because of the way Kaggle calculates scores for the public leaderboard, we could spend another six months chasing a last few percentage points, but it's time for us to move on and look at other areas. Meanwhile, the best way to learn is by doing. See you next time.

downtime

» CARMEL SEALEY LEVELS UP AND HEADS ONLINE TO FIND OUT THE LATEST IN GAMING NEWS

UK's NHS to launch a clinic for gaming addiction

[CENTRE OF INTERNET DISORDERS] TO BE A "LIFE-CHANGER"

In the wake of the World Health Organization's official classification of gaming disorder as a mental health condition, a London hospital is opening a clinic dedicated to tackling gaming addiction. While the clinic's founder doubts this will result in "an epidemic" of people requiring treatment, she does believe it will be a "life-changer" for many struggling with the disorder. "I feel a moral duty on behalf of the NHS to provide the evidence-based treatment these young people and their families need", she said, going on to say that the centre will expand to also include "other internet compulsions [...] when funding is available."

The Nintendo Switch has sold almost 20 million units

THE JAPANESE GAMING GIANT GETS BACK ON TRACK

Considering the console has been out for roughly 18 months, the fact that the Switch is fast approaching the big 20-million-units-sold mark (as of figures released by Nintendo in late June) is an undeniable indication of its success. According to the numbers, this is approximately on par with how the market-leading PlayStation 4 was doing at this point in its life cycle. While the portable console from Nintendo is not directly competing with the Sony giant, the Switch has already smashed past Wii U sales, with no visible signs of slowing.

Microsoft rumoured to be working on two new consoles

Projects Scarlett and Scarlett Cloud are the company's newest gaming endeavours.

While we're sure Scarlet and Scarlett Cloud won't be the names plastered across the boxes when they appear on shelves, those are said to be the dev titles for Microsoft's next Xbox hardware devices. Despite the fact that the Xbox One X (previously known as Scorpio) is still fairly new, it appears that Microsoft is already making plans for its future, although no official announcements have been made yet.

Project Scarlett is reportedly the codename for the next major console. In fact, at this year's E3, Xbox Chief Phil Spencer hinted that the company was working on more than one, stating that "Our hardware team is deep into developing the next generation of Xbox consoles". When this new hardware is set to land, however, is anyone's guess; it's likely to be 2020, when Sony's PS5 is also predicted to land.

Scarlett Cloud – potentially the second console that Spencer was referring to – could be a game-streaming device and subscription service. This lightweight system would rely on a remote server to provide the processing and graphical power, allowing the user to stream games directly to the TV.

Playing Minecraft could help invigorate your child's love of literature

GAME IS BEING USED TO RECREATE BOOK WORLDS IN 3D.

Minecraft has been used to create truly incredible digital feats of architecture, including replicas of the Burj Khalifa and the Empire State Building, the entirety of Vienna and also fantasy cities like Adamantis and Westeros' port city of Sunspear. Now, a group of creative folk from Lancaster University are creating Litcraft — a platform allowing children to explore the digital worlds described in some of the most classic books of all time. So far, the group has breathed new life into *Treasure Island*, recreating Skeleton Island as true to the text as possible.

While traversing the island in search of buried treasure might sound like a great day out, the creators of Litcraft have more than just fun on their agenda. They intend to use their maps to encourage primary and secondary school audiences to "engage with landscape and world design", something that English lessons don't really touch on. The team hopes that this will encourage people to rediscover the classics, especially the ones "in which the landscape is key". Litcraft has been fairly tight-lipped about which books will be recreated next, but we're personally hoping to visit Mordor, Narnia or Lilliput.

Game developers reform their social media policies

In the wake of reactive firings, devs look to protect their staff.

According to a report by *Kotaku* (tinyurl.com/apc459-arenanet), many female developers have raised concerns over the willingness of some game studios to cave to social media pressure. This came about after the firing of Jessica Price, a female narrative designer working on *Guild Wars 2*, who publicly called out a player on Twitter she felt had attempted to mansplain her job to her. This led to the usual online rampage of insults and threats thrown Price's way. Days later, developer ArenaNet fired her for "failing to uphold [its] standards of communicating with players" and attacking the community, supposedly also for prior unspecified incidents online.

Despite the muddiness surrounding Price's firing, other women in game development have since come out in support, shedding light on the continued abuse women receive from "organised" groups within the community. This has prompted some studios to issue statements reinforcing their support for their staff and calling out the online mob's "entitlement culture". However, this is creating a balancing act between the need for studios to stay open and their willingness to interact with their audience online, while also attempting to make a stand against a small and rather toxic percentage of that audience.

Steam game *Abstractism* accused of hijacking computers to mine cryptocurrencies

TITLE PULLED FROM VALVE'S PLATFORM IN RESPONSE.

While Valve has been called out recently for having loose morals with regards to the content it allows to be sold on its platform (see issue 79), it did not leave time for questions when it removed the game *Abstractism* from its store. Despite the fact the game itself claimed to be a "relaxing" platformer, YouTuber SidAlpha spotted some peculiarities with its microtransactions, some of which belonged to different games or were entirely fake items altogether.

After others spotted issues with the game, including a Malwarebytes scan which flagged one of the executables as a threat, the devs claimed that those "applications are gaming launchers". However, when one user said that *Abstractism* was using gamers' computers to mine Bitcoin due to its heavy CPU and GPU power requirements, the devs responded with "Bitcoin is outdated" and that they "currently use *Abstractism* to mine only Monero coins". Then perhaps realising what they'd just said, added, "*Abstractism* does not mine any cryptocurrency" and claimed that the user was simply playing on a high graphics setting.

Steam leak reveals top 1,000 played games on the platform

OLD FAVOURITES STILL DOMINATE.

While Steam released a fairly vague list of its top selling games of 2018 mere days before, a leak allowed more telling data to become known in early July. The leaked information claimed that while gamers are eager to try out new games like *PUBG*, the most popular games still being played on the platform are older titles, like *Team Fortress 2*, *Counter-Strike: Global Offensive* and *Left 4 Dead 2*. Seems like you can't replace old favourites!

EA says online game streaming will eliminate consoles in future

NOW YOU CAN ADD 'SKYRIM: CLOUD EDITION' TO YOUR EXISTING COLLECTION OF SKYRIMS.

EA's new Executive Vice President of Strategic Growth (that's corporate-speak for soothsayer), Matt Bilbey, believes that, while game streaming at the moment is being held back by server infrastructure and bandwidth limitations, it's likely that will change in the coming years. He suggests that traditional consoles may give way to smart TV streaming solutions with subscriptions "similar to Netflix" and where the "console actually exists in the smart TV", or even where "the next PlayStation just exists on your phone". ■

SWITCH | $89.95 | WWW.NINTENDO.COM.AU

Octopath Traveler

A gorgeous, staunchly old-school JRPG.

Nearly 50 years since *Pong*, games have evolved at a startling rate. And yet here we are, in 2018, with a high-profile Nintendo exclusive that feels more like something from the 1990s than most other games that reference that era. *Octopath Traveler* is a staunchly old-school JRPG: its gorgeous 2.5D pixel-art aesthetic is the only factor separating it from a ye olde 16-bit *Final Fantasy* game.

Mixing 2D character sprites and 3D, almost pop-up-book-like environments, *Octopath Traveler* is quite unlike any other ostensibly retro-styled game on the market. The way its sands shimmer and its waterways glisten, catching the sun's rays just so, is beautiful. Its snow fields appear so crisp you'll swear you could reach into your Switch and touch them. But your party – recruited one by one, around the centre of the map's least-dangerous regions – can't wander freely, soaking in the surroundings. Combat encounters occur randomly when outside the game's towns, and these turn-based rough-and-tumbles represent another of *Octopath Traveler's* significant strengths.

It, however, demands patience. The game's intro is interminable, with each of the eight protagonists receiving their own opening chapter, showcasing both their background and their unique abilities. Even if you're averse to whimsical fantasy and have little patience for random overworld encounters, it's surprising how much of the frustration is offset by how beautiful the game looks.

That these eight separate tales never satisfyingly tie together is *Octopath Traveler's* greatest failing, though. That certain characters' quests are clearly designed with more love than others, another. But player attachments to their distinct hopes and hardships must often be put aside to guarantee a balanced party of four, split between compatible classes.

When you're trying to move from A to B, only to be interrupted by some weird bug that needs killing, the fact that killing it looks so beautiful makes up for a lot.

The combat system is turn-based, but it reveals surprising complexity even in the opening hour of the game. As you steadily recruit the whole roster of characters, you'll have a large variety of attack-types and strategies to choose from. Enemies must have their guard broken before any serious damage can be inflicted and, most of the time, this can only be achieved with multiple attacks per turn. The combat evolves from slightly awkward to almost balletic, as you seek to earn multiplier points with weaker attacks, resulting in an eventual maelstrom of fury.

And while exploring the serene overworld is possibly this game's greatest pleasure, you'll need to prepare yourself for a lot of this combat. For that reason, despite its unique aesthetic, this is a game that likely won't convert JRPG naysayers. But if you're in the camp of those who adore them, *Octopath Traveler* is utterly essential.

■ Shaun Prescott

Verdict

A beautifully designed retro JRPG, despite some lacklustre storytelling at times.

★★★★☆

PC, PS4, XO, SWITCH | FROM $30.95 | DEAD-CELLS.COM

Dead Cells

Dying really is an awfully big adventure after all.

You might think, not unreasonably, that a game which begins with your character already dead – decapitated, a condemned prisoner way past the point of appeal – might be extraordinarily short. Yet each death, including the first, is a new beginning. You must complete the entire adventure in one sitting, with no extra lives or continues. It's a familiar concept, one that's never been executed so well.

A self-described roguelite, each stage's layout is randomly generated every time you play. The phrase 'no two runs are ever the same' may feel tired in 2018, but it's worth repeating here. Every stage is significantly different every time. The reason this is impressive in *Dead Cells* is that the template of a traditional 2D platformer is used, complete with locks, keys, ladders, and more, and each layout feels handcrafted. There's the occasional dead end, but this is forgivable.

Any comparison to *Dark Souls* is extremely misleading. This is an action platformer with fast-paced combat, where nothing can one- or two-shot you if you're at maximum health. Indeed, the longer you survive, the longer your total health bar will grow (for that run). You'll occasionally come across scrolls which simultaneously buff your health bar and the damage dealt by colour-coded weapons. This is where the first element of long-game tactics comes in. For example, do you select the scroll that offers a 60% health bar increase, yet powers up green weapons (of which you currently have none), or the red one that offers less health, but buffs your sword by 15%?

Alongside your dodge roll you can carry two primary weapons (choose from sword, bow, shield), and two cooldown-reliant support weapons. A shield allows you to parry with generous timing, opening up a whole new can of worms. A bow helps keep foes at a distance, while a melee weapon allows you to deal damage without worrying about ammo. It's the distribution of all these items that helps make the experience so compelling.

Needless to say, luck plays a large part in which weapons you come across, and which effects those weapons carry, in any run. But by collecting and spending blueprints and Cells from enemies, you'll slowly but surely unlock permanent twists. A health-restoring potion, new weapons, the ability to start with a random weapon from your unlocked pool... these are small but important additions that help keep things fresh.

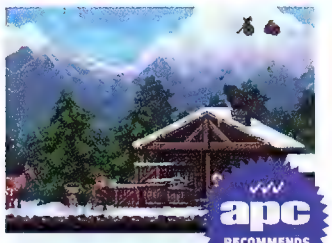
It says much that the first time I get as far as defeating two bosses and five stages before dying, my instant reaction is not frustration, but to dive back in with renewed determination and confidence. You'll keep seeing the same handful of biomes, yet it never gets old. Chances are, this game will never be dead to you.

■ Luke Kemp

Verdict

You learn by dying, yet this never feels unfair., making it compelling and endlessly replayable.

★★★★½



Chasm

How low can you go?

PC | US$20
WWW.THQNORDIC.COM

Having been successfully funded on Kickstarter back in 2013, this charming Metroidvania-style underground adventure has taken some time to see the light of day, but the wait has been worth it. Taking control of a young recruit on their first mission, you venture into the mines in search of missing townsfolk and stumble upon a subterranean world, unfurling an intriguing tale of an ancient cult.

Returning the mislaid populace not only nets you major good-guy points, you can also avail yourself of their services, including blacksmithing and wielding magic. This allows for the slow unveiling of the game's various mechanics. The varied and colourful cast of adversaries, from pesky bats to boomerang-slinging skeletons, require their own careful and considered formula of attacks, evades, and jumps, making battles a veritable dance with death, and racing through the labyrinthine levels is sure to be met with a quick demise. With its challenging combat and relatively scarce supply of healing items, this cute action platformer feels a lot like *Dark Souls* done with pixel art.

While *Chasm* doesn't offer anything particularly new to the genre, it does deliver intricate locations and satisfying swordplay in spades.

■ Anne-Marie Coyle

★★★★

Moonlighter

Slayin' and sellin'.

PC, PS4, XO | $39.95
MOONLIGHTERTHEGAME.COM

Looking for another old-school top-down action RPG with pretty pixels? *Moonlighter* does the job rather admirably. But forget adventuring; it's your protagonist's other humble profession that will hook you in. As the game's merchant, the purpose behind your dungeon-crawling is to grab whatever loot you can carry so you can sell it in your shop. With no clue as to the items' value, it's up to you to set the prices. This becomes an utterly compelling process as you gauge your customers' moods and work out whether they think your price tag is right, extortionate, or a bargain. The beauty of it is that you can tweak the prices in real-time before selling a whole stack, then sneakily raise the price as that cash register chimes.

All this is to give you the funds to keep fighting in the dungeons, as money talks elsewhere. You'll want to craft better gear and potions in order to take on tougher enemies, who drop more valuable loot, which you can sell for even more expensive upgrades. And so this loop goes, unleashing your inner capitalist.2 Moonlighter might not have anything close to, say, *The Binding Of Isaac* in terms of replay value. But you definitely won't want to give up the day job.

■ Alan Wen

★★★★☆

PC, PS3, PS4 | $79.95 | WWW.YAKUZA.SEGA.COM

Yakuza Kiwami 2

Ki wa me in for a second serving.

Kazuma Kiryu's trademark back dragon tattoo has been re-inked with the vibrant shades of *Yakuza 6's* Dragon engine in this complete remake..

The story has its roots in the massacre of the Korean Jingweon mob in the 1980s, dealing with ramifications from the perspectives of the police and Tokyo's Tojo family. This interferes with a proposed alliance between the Tojo and Osaka's reigning Omi family.

Kiryu is obliged to help broker the alliance himself, only to butt heads with the Omi's very own dragon-tattooed badass, Ryuji Goda, son of the Omi's patriarch. After things hit the fan, Kiryu is forced to team up with Kansai policewoman Kaoru Sayama, known as the "yakuza huntress". Hounded at every turn as they try to unpick the complex web of events, , they move back and forth between the neon streets of Tokyo's Kamurocho red light district, and the distinct riverside takoyaki-filled streets of Sotenbori, Osaka.

This remake comes at a good time, following on from the first game's remake, Yakuza Kiwami. It sets a high bar for remakes everywhere.

Connections to Yakuza 0 and Kiwami come in the form of some of the extra content added to this release. Both the cabaret club management and the clan creator return, but more spruced up, with their own stories to play through.

As usual, the world is packed with the sort of other diversions you'd expect: arcade versions of Virtua Fighter 2 and Virtual-On, a driving range, a batting cage, karaoke, darts, and mahjongg. There's no shortage of distractions, but the cabaret club GP and clan creator really take the idea of Yakuza minigames to the next level. And, of course, there are plenty of sub-stories — side-quests where Kiryu helps the residents of Japan with their often ludicrous problems.

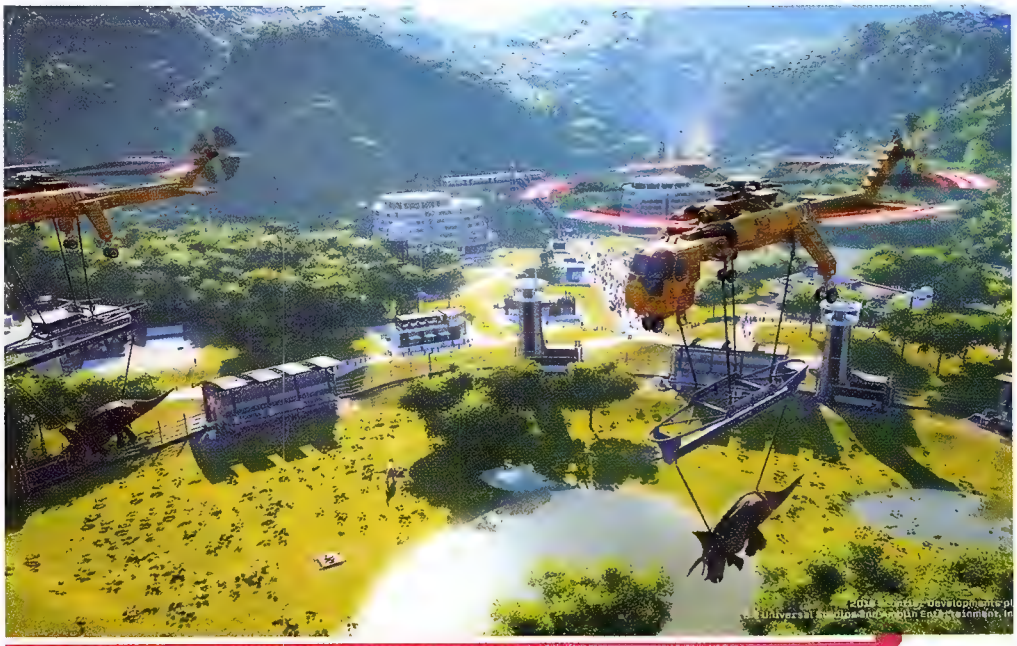
Some of the mission structures can get a bit tiresome, but, as far as remakes go, *Yakuza Kiwami 2* is an absurdly detailed effort, moving one of the best stories in the Yakuza saga forward.

■ Oscar Taylor-Kent

Verdict

This remake is a welcome and impressive return, but the next entry will need a fresh set of threads.

★★★★☆



PC, PS4, XO | $99.95 | WWW.JURASSICWORLDEVOLUTION.COM

Jurassic World Evolution

What happens if you mix Planet Coaster's DNA with that of a best-selling dinosaur franchise?

Jeff Goldblum appears in the top-right of the screen and mutters some twaddle about chaos. Chaos? Ha! There's no chaos here. Our park is running like clockwork, visitor numbers are up, there are six dinosaurs on display, there's a fast-food joint and a clothes shop boosting our rating and... Oh dear, what's that thumping sound? Ten minutes later the last transport helicopter lands and we finally close the emergency shelters, having seen our profits plunge and our guests drop like flies.

Frontier's game takes the thrills of management and adds the very real possibility of your exhibits getting loose and killing people. And they'll get free: the game makes sure of it, despite all your planning and fence-building.

Your parks are scattered across the 'Five Deaths' archipelago familiar from Crichton's novels. Only one of them is a true sandbox, and this needs to be unlocked by getting a four-star rating on the starting island.

The game is obsessed with profit. Luckily, dinosaurs are what the public pays to see, and dinosaurs are what you've got. Frontier has chosen to be scientifically accurate by not including aquatic or flying reptiles. There's a decent selection, big and small, herbivore and carnivore, that need to be housed in paddocks surrounded by fences, with a gate for rangers to enter, water, a food source, and a way for visitors to see them.

Your prehistoric pets have two ratings: health, which is self explanatory, and comfort, which depends on how well their social environmental and gastronomic needs are met. A drop in the comfort rating generally leads to thoughts of escape, leading to a fencing breach and a short rampage around the park before being taken down by a tranquiliser dart and airlifted back into the appropriate enclosure while rangers repair the fence.

The helicopters and rangers are the workforce of a park, and while you can leave them on automatic, it's more efficient to fill a seat on the chopper or jeep and take the medicating or tranquilising shot yourself. Doing this takes you away from your management duties, of course, so there's a balance to be struck.

Jurassic World Evolution could be a sequel to Frontier's 2016 rollercoaster manager – the type of sequel that has slightly fewer features. It tries to hide this behind dinosaurs and famous faces, and it's largely successful in the short term because dinosaurs are awesome and Jeff Goldblum has more charisma as a distorted thumbnail than a whole army of Chris Pratts. By reskinning *Planet Coaster*, Frontier has taken a proven structure and stretched a best-selling covering over it. Most of the game is a tutorial for the sandbox island, and the slow pace of progression leaves you feeling like the training wheels are on for much too long. ■ Ian Evenden

Verdict

Knocks your socks off at first, then settles down into a humdrum management game with dinosaurs.

BlazBlue: Cross Tag Battle

"Don't think. Feel."

PC, PS4, SWITCH | $49.95
ARCSYSTEMWORKS.COM

Mashing together well-loved characters from *BlazBlue*, *Persona 4 Arena*, *Under Night In-Birth*, and *RWBY*, this 2v2 fighter prays you love its roster, because behind the yapping soundbites and dazzling visuals is a simple brawler.

If you loved the tag team nuance of *Dragon Ball FighterZ*, or the meter management and pressuring of *Guilty Gear* and *BlazBlue*, then you'll find *Cross Tag Battle* wanting. This a stripped-back take on Arc System Works' other series, one that puts spectacle ahead of depth. It's not without its systems, however, as you can perform team attacks, activate meter-bleeding Distortion moves, and launch into Extra combos. They're all done at the tap of a single button or quarter circle, and all characters feature the same simplistic combo commands regardless of style.

Cross Tag Battle delivers finely balanced, fast fights; it's a perfect entry if you're new to the chaos of anime fighters. Each character is beautifully animated, moves clash with vibrant colour, and fans will certainly find value in teaming up their favourites. Yet *Cross Tag Battle* finds a way to punch itself in the face: half the roster is missing, and will only be available as paid-for DLC. That's not the fan service you may have expected. ■ Luke Kemp

Game director and writer Ken Levine is part of the Looking Glass Studios alumni, cutting his teeth on System Shock 2 and Thief: The Dark Project

RELEASED: 21 AUGUST 2007 | PUBLISHER: 2K GAMES | DEVELOPER: IRRATIONAL GAMES
SYSTEM: XBOX 360

GAME CHANGER

BioShock

An unforgettable adventure cast beneath the waves, it was BioShock's immeasurably enjoyable shooting and unforgettable narrative that make it one of the most important releases of the last decade.

"Would you kindly?" On the surface, it was always a simple quandary to wrestle with. We answered the call dutifully, locking ourselves into a wicked sense of forward momentum at the whim of an omnipotent narrator, pushing ourselves ever deeper into a submerged metropolis steadily taking on more and more water. But, as BioShock players would soon discover in the autumn of 2007, the question itself was loaded. A smoke-and-mirrors tactic that has come to define a certain era of first-person shooters – particularly in the hearts and hands of console-bound gamers.

One of the greatest magic tricks game developers ever pulled off was making it feel as if you ever were free inside of their worlds. There is, in any player-driven narrative experience – be it linear or otherwise – merely the illusion of choice and control. The medium is inevitably limited by the amount of content a team is able to create and implement; making players believe that they have even the slightest amount of influence on how events and story unfolds is all a part of a good narrative. BioShock turned this on its head entirely. It turned a trusted narrator against us; it forced us to confront the

Key facts

Rapture actually exists on Google Maps. Visit the coordinates 63' 2' North 29' 55' West and you'll find the site of the infamous Lighthouse. It's really cool, although we advise you to keep your distance from it at all costs.

The philosophy behind the creation of Rapture is heavily inspired by the works of Ayn Rand, and many of her concepts and ideas can be seen throughout the world and the story of BioShock.

"One of the greatest magic tricks game developers ever pulled off was making it feel as if you ever were free inside of their worlds."

relationship between the sentience of the protagonist and the invisible guiding hand of the developer.

While the late game twist forced players to consider their own agency – to weigh up the numerous violations of trust and our inherent inability to question them throughout – the world of Rapture is appropriately established to drive reactive player emotion from the moment that the bathysphere first opens its doors. It's a beautiful, wondrous place; its rusting 1950s aesthetic inviting us to explore the chaos beneath the waves, begging you to hope that the wrench you get your hands on will one day have another use besides beating in skulls – that perhaps by the end of this you can restore Rapture to its former glory. But soon that feeling is replaced with something else entirely: oppressive, aggressive fear. As, one by one, the layers are peeled back on the city, its citizens and the dark politics fuelling the disarray, any hope you have is quickly replaced by a desire to escape it all as quickly as humanly possible.

On your way to freedom, guided by the warring of words between Atlas and Fontaine, empathy with the citizens of Rapture is established, largely through environmental storytelling. It's the first of many emotional tethers Irrational Games creates throughout the experience as it builds towards its twist reveal. While this manifested itself in fairly rote fashion – rooting through bins and listening to scattered audio diaries across the world – it helped the world feel real, like it had existed before you arrived and that it would continue to be after you eventually left it all behind. Forcing you to empathise with the very villains you were so intent on crushing only made the emotional moments – between deciding whether you would save the tortured Little Sisters or harvest them for resources – more impactful.

BioShock brought the immersive sim to console in a way that we hadn't quite experienced before. The game does invariably share its DNA with the likes of System Shock and its sequel, on which director Ken Levine first cut his teeth, and that ensured that BioShock had a proficiency to its core systems lost on many other genre games of the time. The feel of the weapons, their combination with the array of otherworldly Plasmids at your disposal, was a real delight. The action was fast and kinetic, but nuanced enough to let us experiment with the tools you had found along the way – the enemy AI smart and aggressive, the depth to the combat system only expanding the further you dared push it. Seeing a Big Daddy wade into battle was forever a thrill, particularly as the various warring factions would converge as if by complete accident. BioShock offered some of the biggest thrills the infant console generation had seen, and its impact on the story-driven shooter is difficult to quantify.

Its lacklustre ending aside, BioShock was able to convincingly tell a story that any other medium would struggle to deliver. Irrational capitalised on the strength of the interactive format and delivered a narrative that is as challenging as it is unique; in playing with perception, trust and consequence, BioShock made players more aware of their agency than ever before. To be betrayed by your own actions – your own lack of awareness or perception – was startling. The action and combat sublime, the character development and world-building unrivalled. A decade on and it's as wonderful today as it was then; BioShock is a startling example of what can be achieved when a bold vision is achieved wholeheartedly by a group of passionate creatives. ■

Most terrifying foes

The scariest enemies you'll encounter on your trip through Rapture.

Splicers

Adam may have once represented a bright future for Rapture, but it quickly led to disarray after armies of plasmid-infused splicers began to form. Smart, agile and tough in packs, the splicers, once overdosing citizens, are formidable terrors throughout the entirety of BioShock.

Big Daddies

The Big Daddies were humans surgically grafted into giant diving suits, psychologically compelled to protect the Little Sisters at all costs. Affectionately named "Mr Bubbles" by their wards, if you saw one of these charging at you, you just knew you were in for a tough battle.

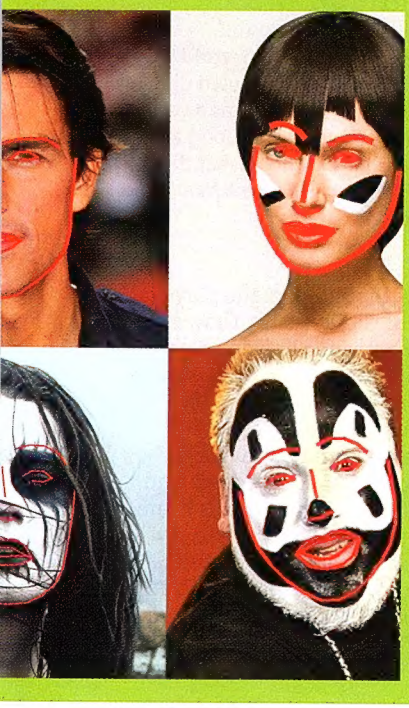
The world

Enclosed in a bathysphere, the world of Rapture was a nightmare in its own right. Rich in detail, the city was used as a vehicle to tell the stories of the citizens long after they had departed. You know what they say: there ain't no party like New Year's Eve in Rapture circa 1958.

Yes, Microsoft Office Championship is a thing

Student to represent Australia in Florida.

Microsoft Office is a set of complex content creation tools with dozens of menus that we personally never use for fear of getting lost in a labyrinth of unwanted columns, uneven paragraph spacing and default styles. However, there is a rare breed of human out there that knows how to use the software in its entirety so well that one of these individuals has won the Australia National Championship for Microsoft Word. Yes, Aidan Smith – of All Saints College, Perth – won the trip of a lifetime and recently travelled to Orlando, Florida, to participate in the Microsoft Office Specialist (MOS) World Championship along with 151 other finalists from around the world. Aidan managed to clinch seventh place in the championship, which included being tested on his ability to create spreadsheets in Excel, docs in Word and presentations in PowerPoint. So where to now for our champion? According to the Vice President of Worldwide Education at Microsoft, the skills he has learnt and the certification from MOS gives him "tangible proof" that he knows "how to use Microsoft Office tools in academics and on the job from day one". At the very least, it should help to pad out his resume.



Clowing your way past facial recognition technology

JUGGALO MAKE UP CONFUSES ALGORITHMS.

This one probably needs a little explanation. A juggalo is a hardcore fan of the US hip-hop group Insane Clown Posse, and like the band members themselves, they enjoy wearing predominantly black-and-white face paint akin to evil clowns. After a large number of them marched on Washington last year to add their voices to the many politcalprotests, it was discovered quite by accident that their face paint effectively countered facial recognition technology. According to WonderHowTo's computer security and privacy researcher Tahkion, "if you want to avoid surveillance, become a juggalo". Facial recognition works by relying on certain visible points, such as the location of the nose, height of the eyebrows and width of the mouth. Once someone applies juggalo-like paint to their face – something that often involves designs that run contrary to the natural contours of the wearer's face – it confuses facial recognition systems, resulting in incorrect estimations.

Teenagers want plastic surgery to match their favourite Snapchat filters

SNAPCHAT DYSMORPHIA IS ON THE RISE.

Never before has the phrase "What's the world coming to?" been more appropriate. According to Dr Neelam Vashi, who coined the term 'Snapchat dysmorphia' (a new arm of OCD called body dysmorphia disorder), teens are becoming even more obsessed with facial features, and are asking surgeons to make them look like their favourite Snapchat filters. "I think social media [...] becomes a trigger for people to become very preoccupied with how they look," Dr Vashi said to Inverse, adding that the type of procedures that surgeons are asked to perform have drastically changed. Where once 'rhinoplasty' (a nose job that smooths down the bridge) was a very popular procedure, people are now asking her to make them look like they do post-Snapchat filter, particularly the ones that include larger eyes, fuller lips and asymmetry corrected. "Plastic surgeons will be dealing with this for years to come," Vashi warns.

Microsoft turns to machine learning to decipher the 'least annoying' time to deploy updates

IF THERE ACTUALLY IS SUCH A THING...

Ever PC user will undoubtedly have encountered Windows pop-ups asking them to download an update, then restart their computer. These prompts never seemed to come at a convenient time, either hitting us while we're gaming or just when the creative juices have started to flow and we're finally smashing out hundreds of words for that feature article. Thankfully Microsoft has finally understood how annoying forced updates can be. Instead of letting us snooze the updates (which they added in 2017), the company now has plans to implement a 'predictive model' that will analyse the habits of the user and push out prompts only when the time is most convenient, such as when users are offline. According to a Windows Insider blog post, the new tech will "not only check if you are currently using your device before we restart, but we will also try to predict if you had just left the device to grab a cup of coffee". This predictive model is currently only available as an opt-in service.

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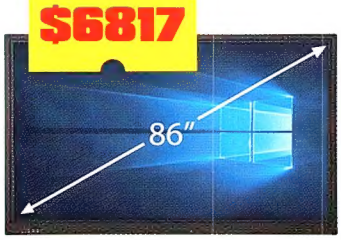

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